THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1892,

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THE DECLINE OF SWAGGER.

UNDER cover of this title, our contemporary, the *Spectator*, showers a volley of mixed opinions upon mortals in general, and "scientific gentlemen" in particular. The writer points to the decline of swagger as one of the signs of the times, and declares that "the most obvious and disagreeable form of self-assertion, which consists in making other people conscious of their inferiority by intensely unpleasant and supercilious behaviour, has, of course, been dead and done with as a social claim, for half a generation." In fact, that swagger, with but few exceptions, is fast disappearing in all classes of society, from the "lotus eaters" of club-land, to the "heavy plunger" swagger of the military man. And having traced the "decline and fall" of the empire of self-assertion in a manner almost worthy of a Gibbons, the writer proceeds to discuss the existing specimens of swagger, but in a style far too weak for one who would simulate Addison. For Addison was never known to diminish the force of his argument by blindly drifting into the very errors against which he was fighting. For instance, if he had been declaiming against the vice of self-assertion, he would have abstained at least from such an excess of that commodity as appears in the article we are now discussing.

Speaking of "scientific gentlemen," the *Spectator* observes: "No doubt wisdom cometh with understanding; but we wish that those men of the age, the 'scientific gentlemen'—scholars are rather down in the world just now—could discern the signs of the times in the matter of swagger. At present they possess, with Jews, mushroom financiers, and very successful tradesmen—the Egerton Bompases of the day—almost a monopoly of the amount of obvious and positive swagger visible. Whether in public controversy or social intercourse, the scientific person sometimes swaggers with unquenchable energy." And, again: "These sterling qualities have so endeared him to the social circle, that the mere reference to a "Professor—an honourable title which seems to be monopolised by the expounders of natural science—is usually enough to drive any number of plain men half frantic. . . . But swagger, though not confined to *parvenus*, is, after all, the *parvenu's* besetting temptation; and the 'scientific men' are the *parvenus* of knowledge." Unless such an invective as this can be included under the more general term of "arrogance," it must remain as the finest specimen of "swagger" which has ever been written against scientific men.

Certainly there is a sense in which those who are accustomed to scientific methods of thought are at disadvantage in a mixed society of casual spectators, tatlers, and guardians of everybody's affairs. For professors of natural science have an unsocial habit of stating facts as they are, and not after the manner in which such a society wishes and dreams of them. A flat world is far easier to criticise than a round one—you

can see so much more of it at a time. It was a hard task to assure the critics that the world was not made for them to strut up and down upon.

But while the true Professor delights in *assertion*, he steadily denounces *self*-assertion; he scorns arrogance. Huxley observes that "the most ardent votary of science holds his firmest convictions, not because the men he most venerates holds them; not because their verity is testified by portents and wonders; but because his experience teaches him that whenever he chooses to bring these convictions into contact with their primary source, Nature—whenever he thinks to test them by appealing to experiment and observation—Nature will confirm them. The man of science has learned to believe in justification, not by faith, but by *verification*."

There is a great difference between the assurance which arises from knowledge, and the self-assertion which springs from ignorance. The certainty with which a professor of science expresses himself is due, not to any confidence in his *personal* opinion on a given topic, but in his belief in the universality of order, and his confidence, at all times and under all circumstances, in the law of causation. It has been well said that "all great men not only know their business, but usually know that they know it, and are not only right in their main opinions, but they usually know that they are right in them; only they do not think much of themselves on that account."

There is no better antidote against entertaining too great an admiration for scientific men, than to possess a deep sense of the absolute validity and authority of orthodox and crystallised opinions—however irrational those opinions may be.

THE ECONOMIC ASPECT OF SEWAGE PURIFICATION BY ELECTRICITY.

THE consideration of cost in relation to sewage matters is, as we all know, not only important, but absolutely vital. In the case of any process otherwise fairly effective, we must ascertain what the working expenses may be, for, of course, the process may be put out of court simply on account of the prohibitive cost of working it. Therefore all examination into efficiency must be accompanied by a study of the expense.

The different materials which have been employed in the so-called purification of sewage are, in number, legion, and yet perhaps the great sewage question remains an open one. But most of these materials have been put forward by faddists, not by experts, and the results have consequently been for the most part disappointing; hence, according to Mr. H. Grimshaw, of the Manchester section of the Society of Chemical Industry, the processes for sewage purification which can really claim consideration are only six—leaving out the treatment of sewage by irrigation.

The six processes are:—

A. The lime process.
B. „ alumino-ferric process.
C. „ Barry Company's process.
D. „ International process.
E. „ Clarine process.
F. „ electrolytic process.

The respective merits of these six systems were recently examined by Mr. Grimshaw especially in respect to cost, and he has compiled for the Society of Chemical Industry some exceedingly significant statistics, which are well worthy the attention of electricians who are interested in this great and almost overwhelming question of the proper treatment of sewage.

The figures are chiefly drawn from the results of experimental investigations undertaken at Salford.* Our space will not, unfortunately, allow us to quote the statistics of all the systems, but we will give those that refer to the electrolytic system of sewage purification.

Electrolytic Process (10,000,000 *gallons per day*).
Annual cost at Salford (Newton's report, &c.).

	£	s.	d.
Iron electrodes, 5,400 tons, renewed every five years	4,500	0	0
Labour	1,800	0	0
Depreciation and repairs	1,250	0	0
Coal for working engines	1,900	0	0
Steam engines, dynamos, and works, £20,000 at 5 per cent.	1,000	0	0
Sand filters, six acres, and works, £25,500 at 5 per cent.	1,275	0	0
Manipulation of sludge	1,150	0	0
Total (*ex* royalty)	£12,875	0	0

	£	s.	d.
Cost per million gallons per annum for precipitation	902	0	0
Cost per million gallons per annum for filtration	270	0	0
Cost per million gallons per annum for manipulation of sludge	115	0	0
	£1,287	0	0

Cost per million gallons, 70s. 6d.

Table of Comparative Cost.

	s.	d.
Lime treatment per million gallons	37	1
Alumino-ferric process per million gallons ..	81	9
„ „ „ „ (unfiltered)	75	0
Barry Company's „ „ „	116	10
International Co.'s process per „	54	1
„ „ „ „ { with added ferrozone }	90	0
Clarine process per million gallons	54	2
„ „ „ „ (unfiltered)	40	0
Electrolytic process per million gallons ...	70	6

If these figures are to be accepted, then the electrolytic process must be placed fifth in order of cost—we are not speaking now of *merit*. But if we may judge from the discussion which followed the reading of Mr. Grimshaw's paper at Manchester, these figures are open to question. Mr. A. Bowes was of opinion that a proper comparison of the various systems cannot be made in such an off-hand fashion as attempted by Mr. Grimshaw. The latter admitted that he had to make various hypotheses, but there were various points which were not ascertained.

Mr. Bowes said: "Who can tell you what the 'electrical' system has cost? The amount of coal used for the boilers to drive the dynamos has never yet been measured or weighed." This is a sample of the "points" which have not yet been properly ascertained.

It is a pity that the proprietors of the electrical process have not published easily get-at-able statistics regarding their process; hence Mr. Grimshaw had to rely upon the Salford figures alone. We can scarcely be expected to form an opinion from one set of experiments alone; at least, it is not the true scientific way. A large mass of results should be first accumulated, and then we might be in a position to generalise.

* See ELECTRICAL REVIEW for April 17th, 1891.

We may note that in efficiency Mr. Grimshaw again, judging from the Salford results, places the different systems in the following order :—

1. The Clarine process.
2. „ International process.
3. „ electrolytic process.
4. „ Barry Company's process.
   „ alumino-ferric process.
   „ lime process.

THE SUBMARINE SENTRY.

JUST now, when the agitation for the establishment of communication round our shores, with a view to lessening the terrible loss of life and property which occurs only too frequently, has almost secured the success it so well merits, it may not be out of place to draw attention to any appliances which, on the principle that prevention is better than cure, are deserving of notice.

It is stated that as many as 50 per cent. of the wrecks are caused by stranding. Some of these, notably in the case of sailing ships and steamers in distress, are perhaps not preventable, but a considerable number might be prevented were ships provided with every possible appliance for aiding navigation.

In the good old days if a ship got into trouble it was generally due to carelessness with regard to the three L's (lights, look-out, and lead), and this is just as much the case now as ever. Modern improvements in the form of ships and their engines have completely revolutionised shipping. Instead of ships running at a maximum speed of say 10 knots, we have steamers tearing along, even in narrow waters, at a speed equal to that of an average railway train, and consequently appliances which used to answer every requirement no longer do so. Where is the use, we should like to know, of casting the lead in the ordinary way, when a ship is going at such a speed that she might very well shoal the water and run aground before two consecutive soundings could possibly be taken ?

No one can be blamed for using defective appliances so long as nothing better exists, but in this case something not only does exist, but is within the reach of even the most cheeseparing shipowner.

In June last year Professor Lambert, of the Royal Naval College, Greenwich, brought to public notice at the Royal United Service Institution, an invention of Mr. Samuel James, C.E., called the "Submarine Sentry."

The sentry consists of a wooden kite which is streamed in the water in just the same way as an ordinary kite is flown in the air. The conditions as to angle, weight, and size, in relation to the wire used to tow it, are so arranged that the kite can be towed at any depth by paying out the necessary length of wire, as shown by an indicator, and it remains at this depth whatever may be the speed of the towing ship.

Although it is at once apparent that the principle of the arrangement is perfectly sound, we, in common with many others, were inclined to think it would work only on paper, but this opinion was completely changed on seeing a trial of the instrument. Anything more beautiful than its absolute steadiness could not be wished for. On the necessary quantity of wire being paid out, to tow the kite at the required depth, it immediately turns over and dives down, the angle of the wire becomes rapidly greater till it reaches about 45°, at which it remains constant, while the wire begins to vibrate, and sets up a hum which can be heard at some little distance away.

As long as the depth of water is not less than that at which the kite is set, everything remains in equilibrium, but as soon as the water shoals ground is struck by an arm projecting from the bottom of the kite and one side of the bridle, to which the towing wire is attached, is released. On this the kite rises to the surface, and a bell rings on board the ship.

The depth at which a kite can be towed is only limited by the tensile strength of the wire employed. Given a wire of sufficient strength, by increasing the size of the kite it could be towed at any depth. At present the tensile strength of steel wire of suitable size is limited to about 140 tons per square inch of section ; by the employment of this a depth of 55 fathoms can be reached and maintained with the ship going over 15 knots.

It is a remarkable fact that within the short space of a few days three very valuable ships have lately got aground under circumstances which make it almost certain that had they employed the submarine sentry they would have escaped.

The invention has also an important bearing on submarine telegraphy, and, as might have been expected, has very soon been taken up. One of the testimonials Mr. James most values, comes from the engineer who laid the cables of the Société Française des Télégraphes Sousmarins in the West Indies last summer.

THE PROPOSED PACIFIC CABLE.

THE New South Wales Government have recently announced their willingness to subsidise a cable which will give an alternative route to Europe. It is proposed that this cable should start from Gladstone, a little to the south of Rockhampton, in Queensland, and from thence go on to Fiji, Samoa, and Honolulu, finally landing at some point on the coast of North America. The Government of Victoria, however, is now unwilling to assist this scheme with a subsidy. On a former occasion it was New South Wales which blocked the progress of this work, their representative, the Hon. Charles J. Roberts, who acted as Chairman at the Postal Conference held in Sydney, voting against a resolution recommending a special survey of the Pacific cable route, the expense of which it was proposed should be shared by the Colonies with Great Britain and Canada. The resolution was supported by all the Colonies represented, including Victoria, but was voted against by New South Wales. This opposition, which has been attributed to inter-colonial jealousy, was the means of delaying the examination of the cable route. The survey is, however, being carried out by the English Admiralty, who, unfortunately, cannot devote more than a limited amount of attention to the work. The United States ship *Albatross* has recently sounded the bottom between Honolulu and San Francisco along this

route. Apparently those of the Australian colonies which are at present holding back in this matter, are awaiting experience as to the probable amount of the loss which they have agreed to share equally with the Eastern Extension Telegraph Company, consequent on the reduction of the rates on messages between Australia and Europe. It will be remembered that in May, 1891, the cost of public telegrams was reduced about 50 per cent. This reduction of tariff, as was pointed out by the President of the Conference held at Adelaide, involved the Colonies in "an immediate responsibility of about £60,000 per annum, in addition to the present subsidies of £32,400 in respect of the Port Darwin cables, and £4,200 in respect of the Tasmanian cables." Thus, in consequence of the reduction of rates, the "immediate responsibility" of the Australian colonies towards the Eastern Extension and allied companies amounted to £96,600. It was then anticipated that this amount would be diminished, if not altogether annulled, by the increase of traffic, due to the lowering of rates.

Now, in the *Cape Times* of 20th ult., we read that in reply to a deputation, who asked for a reduction of rates to South Africa, Sir James Anderson, who is also a director of the Eastern and the Eastern Extension Telegraph Companies, "declared that, with the experience of a lifetime, the general result of such a policy was that if the rates were lowered 50 per cent., business increased about 25 per cent.; if lowered 75 per cent., business might increase 50 per cent., but not more; if lowered 25 per cent., no increase of cabling was perceptible at all." Now, if the reduction of about 50 per cent., which has been made in the cost of traffic with Australia, yields an increase of only 25 per cent. in business, this means to the combined Australasian colonies an annual charge of something like £40,000 (in addition to the subsidies of £36,600) as long as the agreement lasts. That this estimate is not far from being correct, can be deduced from Sir John Pender's letter to the Agents General of the Australasian colonies, in which, when proposing reduced rates, he states, when referring to a reduction almost equivalent to half rates, that if the traffic were increased by 25 per cent., the Governments would have to pay £40,314, which, added to the existing subsidies, means an annual charge on the colonies of nearly £77,000. Under these conditions it is not astonishing that, even at this late hour, New South Wales should reconsider her position, and manifest her willingness to assist in establishing an alternative line, as the cost to the Australian colonies would be less than the amount of their present loss, and the benefits to be obtained are many and obvious.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

IN the old days when technical journals were privileged to send a representative to the Institution meetings for the purpose of making a *verbatim* report of the proceedings, both the paper or papers read, and the discussion which followed, could generally be perused in our pages, and those of our contemporaries the following week. Now that we have to content ourselves with authorised abstracts things are not as they were.

As pressure of business apparently renders weekly meetings necessary, it is annoying to be obliged to wait for days after a paper is read before receiving a copy, and it is positively aggravating to be kept still another week for drawings to illustrate the text. However everything comes to those who wait, and the discussion which took place on Thursday last week brought out several points which will form the theme for a few comments. The remarks of Mr. Gray, we consider, as being eminently sensible, and it would be well if gentlemen practically engaged in manufacturing apparatus or materials, which the bulk of the speakers who *will* talk at these meetings know nothing of except by name, could be more often induced to relate their experiences; professors would then listen with equanimity to statements which now startle them.

We well remember some eight or ten years ago a sample coil of some hundreds of yards of American insulated wire being placed in the hands of the late Robert Sabine for reporting upon. It had a high initial insulation resistance and a low inductive capacity per knot, which at the outset spoke volumes in its favour. After a short time, however, the insulation went down and the capacity rose, until after a few weeks in water the capacity had increased to several times its initial figure. This only showed that the material was porous, and that the water had been gradually creeping through the insulator and approaching nearer and nearer to the copper conductor; the material was mainly composed of a mixture of old goloshes, macintoshes, and rubber boots, and was naturally condemned as useless for the purpose intended.

At a still later date another material exploited in England was brought to us and condemned; it was then explained that two kinds of the compound were manufactured, one for insulating cables, and an inferior kind as a substitute for shoe leather, and that probably by mistake a sample of the latter had been forwarded, but as we never received a second batch, the explanation may be taken for what it was worth.

The remark attributed to Mr. Raworth, that it was rather a shock to hear that high insulation resistance was no proof of goodness, shakes one's faith in the knowledge supposed to be possessed by electric light engineers of the most important and vital part of the plant with which they have to deal. Old cable hands must imagine that the days of their boyhood have returned to hear such expressions as these, for to all who have had any experience in the manufacture or testing of insulated wires, it is a matter of common knowledge that adulteration with foreign matter will give a much higher insulation than the pure gum itself possesses; we can, therefore, only think that Mr. Raworth's remarks have been erroneously reported.

The results of Mr. Siemens, showing the influence of E.M.F. on insulation resistance, ought to be taken with some reserve, at least so far as gutta-percha and India-rubber are concerned. In the ELECTRICAL REVIEW for April 11th, 1890, we gave some particulars of tests, which we here reproduce, and which confirm those given by Mr. Preece in his paper:—

The core was tested in water maintained at a temperature of 75° Fahr.

5·0 NAUTICAL MILES OF GUTTA PERCHA CORE.

Temperature 75° Fahr.

Volts ... ... =	15	60	150	300	600
Insulation resistance per N.M., megohms =	1,016	1,027	979	1,048	1,083

3·0 NAUTICAL MILES OF INDIA-RUBBER CORE.

Temperature 75° Fahr.

Volts ... ... =	60	150	300	600
Insulation resistance per N.M., megohms =	3,120	2,966	2,974	3,105

These show that practically the same results are obtained under all the voltages used, and whatever differences are noticeable can easily be explained by errors of observation, in timing the galvanometer deflections, unmeasurable variations of temperature, and from other well-known causes.

We have seen so many different opinions expressed on this matter of voltage affecting the insulation results obtained, that we would suggest the question should be finally settled by one of our large cable manufacturing companies in a series of exhaustive tests made by several independent observers. We do not think it would be a difficult task to make a forecast of the possible influences likely to affect true indications, and the employment of several experimenters would reduce errors of observation to a minimum if it did not actually eliminate them.

Mr. Siemens certainly used just double the highest voltage employed in the tests above, and it is rather a pity that he did not give the figures obtained with 600 cells. The results might then have been more easily comparable, although we believe that had the voltage been carried to 1,200, the cables to which we refer would not have given practically any more divergent figures.

Rock Lighthouses.

A PAPER by Mr. W. T. Douglass read before the Institution of Civil Engineers last Tuesday evening, on the new Bishop's Rock Lighthouse, should be of special interest to telegraph engineers, now that so much attention is being given to the question of establishing electrical communication with lighthouses of this description. It is to be hoped that the opportunity afforded by the discussion, which is to take place next Tuesday, to obtain the opinion of authorities on lighthouses on the matter, will be taken advantage of. We venture to predict that Mr. Douglass and others who have had to deal with the great difficulties met in the construction of lighthouses, would consider the establishment of electrical communication a simple matter. A point of interest mentioned was that although the mooring chains laid down for use by the ships employed in transporting materials of construction to the Bishop's Rock Lighthouse were so chafed that it was necessary to renew them every three months, this chafe was confined to the part which, through the rise and fall of the vessels in a seaway, was on and off the bottom, and the chain which rested always on the rock was quite unaffected.

"A long felt want."

WE have remarked before that the *Globe* "funny man" is infinitely more at home and entertaining in dealing with matters scientific than is the "science-man." The other evening there was a leaderette on electric tramcars, from which we quote the following: "Can the leopard change his spots? Certainly; he has only to take a ride in an electric tramcar to change not only his spots but his whole colouring. How is the transformation effected? Quite automatically, judging from the account just given by a gentleman down in the Midlands, who involuntarily subjected himself to the process the other day. When he entered the car, his nether limbs were encased in garments of irreproachable respectability in point of colour. But when he left the fatal conveyance, they were flaming red, especially the hinder parts, and ribald boys insinuated that he must have escaped from some travelling menagerie. The victim attributes the dyeing to the presence of 'acid or acid fumes' in the car. But if that had been the case, his lungs would surely have entered violent protest against the vitiated atmosphere. Be that as it may, the discovery adds one more allurement to electric tramcars. Without making any extra charge, they will dye you from head to foot at the shortest notice, and thus convert the seediest suit into apparel that Solomon in all his glory never pictured. It only now requires for the machinery to be so adapted as to allow passengers a free choice of colours, for these conveyances to supply 'a long felt want.'"

The Comparison of very High Resistances.

THE short paper read by Major Cardew at a recent meeting of the Institution of Electrical Engineers on this subject did not attract much attention and not surprisingly so. The method consists, briefly, in balancing the unknown high resistance against an adjustable known resistance on either side of an electrometer. So far there is nothing remarkable in the idea; the novelty of the arrangement consists in the adjustable known resistance, which consists of a silk or other thread, which is stated to have resistance of a known value per inch or foot. It is admitted, apparently, that the exact value of the thread requires to be determined by an independent test made by the ordinary deflection method; it is not obvious, therefore, why the unknown resistance cannot be directly determined at once by such a deflection test. Of the stability of the silk thread resistance much doubt might be reasonably expressed, its value is probably as definite as the traditional "loomp of chork" dimension, or the statement, which we recollect once being made by a well-known electrician at a popular lecture, that the ohm was the resistance of a piece of platinum wire about a yard long!

The "Electric-squirt" again.

Fallacia alia aliam trudit—a dictum which we quoted a week or two ago *apropos* of a "Science Echo" in the *Globe*, receives further illustration in the column which the *Daily Chronicle* devotes every week to paragraphs on scientific matters. In Thursday's issue (February 18th) we have the very paragraph from the evening paper which we attacked dished up for the delectation of the scientifically inclined amongst the Liberal Unionists. All the rubbish about the electrified water squirts, the "suits of copper armour," and even the classical allusion to the "torpedo-skate," is here served up again, the writer doubtless feeling quite safe, inasmuch as the supporters of the *Daily Chronicle* are not expected to be likely to take the *Globe*. We should have thought that a great political organ, which boasts of having "the largest circulation of any daily paper in London," would have declined the use of "scissors and paste;" but if the editor of the science notes is unable to dispense with these convenient suppliers of "copy," why does he not consult the leading scientific papers and clip without comment? "Popular science," as expounded in the newspaper columns, is getting worse instead of better. If anything can be dragged in about electricity, the "masses" are sure to be edified; this seems to be the principle, people like to be mystified, and have an idea that electricity is at the bottom of everything. "It's all done by electricity nowadays," or as Jas. F. Sullivan in one of his latest rhymes very neatly puts it—

"All done by electric," says Science to me;
"A-changing vibrations to currents instead,
And back again into vibrations.
By changing of things into others," says he,
"(As light into motion) our wonders are bred
Turn this into that, and you get at the key
Of Science's grand operations."

TANNING BY THE AID OF ELECTRICITY.

THE application of electricity to tanning is progressing, as anyone who has noticed the special exhibits relating to this new industry at the Crystal Palace will agree. Even *Leather*, one of the most conservative of technical journals, is bound to admit in its issue for February that "before long the English trade, so reluctant to embrace any new system, will have to interest themselves in it."

Tanners on the Continent are showing *their* interest practically by putting up testing plant, and, we are informed, generally report favourably upon the rapidity of the process, the economy effected and the quality of leather produced.

The following report has recently been issued by Mr. Georges Hanenstein, at Verviers, Belgium, upon some experiments recently conducted there in "electrical tannage."

The apparatus consisted of a rectangular wooden vat, 6 feet 6 inches long, 4 feet 10 inches wide, and 5 feet 3 inches high, with two electrodes, frame work and shafting, the cost of which was £30 7s. 6d., together with a dynamo, ampèremeter, voltmeter and shafting, &c., costing £24. The installation was capable of supplying six vats.

Forty ox and cow hides from the Brussels *abattoir* were experimented upon, weighing, without the horns, 1,380 kilogrammes. These hides, after having been put in lime, unhaired and fleshed, were swelled and coloured.

The 40 butts derived from these hides were hung up in vats on October 12th, 1891, and taken out on November 16th; they were subjected to the action of electricity during four weeks, or 24 days, from six to seven hours each day. The weight yielded, when finished and dry was 379 kilogrammes.

The offal, bellies, throats, heads, hung up in the vat on November 16th were taken out on December 7th. These parts were therefore subjected to the action of electricity during three weeks, or eighteen days, from six to seven hours per day, and the weight yielded when finished and dried was 344 kilogrammes.

The forty hides, therefore, with a given weight of 1,380 kilogrammes, gave a total weight of finished leather of 723 kilogrammes or $52\frac{4}{10}$ per cent.

The tanning materials employed to swell, colour, and tan these 40 hides, were as follows:

		£	s.	d.
880 kilos.	oak bark	5	5	6
85 „	mimosa bark	1	7	0
700 „	oak extract	6	8	0
		13	0	6

Unfortunately, no details are available as to strength of current supplied during these operations, nor to the cost of driving the dynamo, labour, &c.

THE DISTRIBUTION OF POWER BY DIRECT CURRENTS.*

BY ALEX. DOW.

IT is part of the programme for this evening that I shall advocate the use of direct currents for long distance power transmission. I have taken this task with pleasure, believing that I have a strong case to present to you; but I beg you will remember that what I may say in favour of direct or against alternating methods is said from the standpoint of the engineer, and that as an engineer I must recognise the necessity to the world of each and every line of development now open to electricity. There is no electrical phenomenon which we can afford to say is trifling, and not worthy of careful investigation. But a few years ago the alternate current transformer was merely a scientific toy; to-day it is as practical a piece of engineering as the locomotive. Until now the condenser has had but a limited application in telegraphic work. To-day it promises to become as important to industrial electricity as the transformer. I do not know but that the next few years may see Holtz or Wimshurst static machines built on as large a scale and used as extensively as magneto-electric machines are now.

Therefore, I must consider the power transmission problem as it stands this evening, and leave to those who are prophets and sons of prophets the prediction of what its future will be. And if I, in my remarks, appear to indulge in predictions, it is only guessing, not prophesy. I am entitled to guess, although not New England born; but I "*don't never prophesy unless I know.*"

Of the physical properties of the alternating current, as they affect its use in power transmission, the most prominent are the following: First, its production by the generator and delivery to the motor without the use of a commutator. Second, the facility with which it can be transformed in its E.M.F., either upward or downward, by the use of simple apparatus. These points are in its favonr. We notice, third, that inasmuch as an alternating current has its periods of zero E.M.F., its mean effective value is not the same as its maximum value. It follows that insulation of apparatus to use alternating currents must be calculated to withstand a higher potential difference than that available for virtual work. Fourth, we observe that the alternating current, in its relation to conductors, does not conform to Ohm's law in the elementary form, but to that law as amplified by the introduction of factors of periodicity, range of pulsation, and inductance. The practical result of this is that to convey, under similar conditions, an equal amount of energy, the alternating current requires more copper than the direct current. This fact is not appreciated by the public, although it is familiar to engineers. Before the public the alternating current has been advertised as the current requiring little copper, whereas it may and does sometimes require, under practical conditions, 40 per cent. more copper than the direct current. The fifth physical property which we notice is nearly allied to the fourth. It is merely the fourth property in a special application. It is said that in circuits of great inductance, such as the winding of electro-magnets, the alternating current is retarded in its development to such an extent that a great potential difference or a large current is required to produce magnetic effects which could be produced by direct current with much less apparent expenditure of energy. It is quite true that the expenditure of energy is apparent only, but that does not affect the fact that the windings, if the potential difference is to be kept low, must be of a conductor large enough to carry an enormous current without heating; or that, if the current is to be small, the insulation must be designed to withstand a great potential difference. A parallel observation is that the variable state of an electro-magnet, which only exists at the moments of charge and discharge in a magnet excited by direct current, is continuous when the magnet is excited by an alternating current, and that the loss of power by hysteresis goes on continually in such a magnet.

Now, we must consider in the planning of any given transmission whether the good points of the alternating current do not outweigh the others which are to its disadvantage. In incandescence lighting this question has been answered in practice, and every day continues to be answered. We know that the answer given by practice is sometimes wrong, else we would not see direct current lighting stations located on the outskirts of towns and attempting to light their area at the cost of a large annual interest on copper; neither would we see alternating stations located in the middle of densely populated districts, and sacrificing efficiency on the greater part of their work in order that they may secure with the same system the revenue from a few distant lights. Still the problem is being solved, as such problems must finally be, by the daily progress of the world.

But the conditions of lighting do not correspond with those of power transmission. The advantages which outweigh the disadvantages of the alternating current for lighting purposes are not of so much value under other conditions. Thus, dispensing with the commutator on the alternator in a lighting station and substituting therefor a small self-exciting dynamo to charge the field, is a method both convenient and efficient. Then the lighting transformer, even at its lowest efficiency, is not such a wasteful device that it has not its proper use. But when we come to consider the transmission of power to a distant motor, the problem of how we are to excite the motor is a serious one;

* A paper read before the Chicago Electric Club, January 18th, 1892.

and when we look at the combination of alternator, exciter, step-up transformer at the generating station, plus step-down transformer, exciter and alternator, and some means of giving the alternator field its initial charge, all of which must be provided at the motor station, we are compelled to consider whether the simple, self-exciting, direct current generator, and the equally simple direct current motor are not to be preferred, even with their commutators, and their disadvantage that the E.M.F. to be used on the line must be employed also in the generator and the motor. And it is just those considerations that have so far retarded the development of alternating power transmission. For while the transmission of power by direct current has grown up, parallel with the development of direct current lighting, to tremendous proportions (as witness the use of motors on the circuits of all direct current stations, the magnificent developments of the electrical street car system, and the transmissions of power to be found in all manufacturing and mining districts), there is, so far as my knowledge goes, only one alternating current transmission of power in the United States which can be considered to have passed the experimental stage. That is a transmission in Colorado by the synchronous method, which is doing the work it was set to do well and satisfactorily. Perhaps my statement that there is only one transmission is too sweeping. I make it subject to correction. I once incurred the wrath of a whole community in Nebraska by thoughtlessly saying in public that there was only one tree in the town. Whereas it was well known to all reputable residents that besides the three which were in evidence on the Court House Square, there were also two cotton woods growing out on section 35. I don't wish again to cause similar offence by unqualified statements.

There is nothing wrong with the synchronous method of transmitting power by alternating currents. True, it is necessary to start the motor by some exterior power, but if proper arrangements are made, the starting is no more difficult or tedious an operation than the starting up of a large Corliss steam plant. I think that the 15 minutes before 7 o'clock, which is usually devoted by a mill engineer to getting his engine and shafting into proper motion for the day's work, would be sufficient, if proper arrangements were made, to start up a synchronous motor. True it is, also, that the synchronous motor, when overloaded, "lies down," and declines to do any work at all until the load is reduced to what it considers its capacity. The same statement is correct, as every Sunday school child knows, regarding the model of animal power, the camel, and as any old soldier can tell concerning that much maligned carrier, the army mule; but it has not been imputed unto those animals for wickedness that they would not pull more than they thought they should; it has merely passed into proverb as "the nature of the beast." Then the synchronous alternating motor has an excellent quality which is only equalled by the plain shunt wound motor of the every-day electric light station: it regulates perfectly as to speed, keeping in step, within the limits of its capacity, with the generator which drives it.

And the synchronous motor is not the patented property of one inventor or corporation; it has belonged to the world ever since Dr. Hopkinson's experiments at North Foreland. There is not a company manufacturing alternate current machinery which would not gladly take an order for any number of synchronous power transmissions. The reason that there is not an indefinite number of such transmissions in use is, that the direct current motor stands ready to do the work under all conditions that have yet come up in practice. There is no long felt want waiting to be filled by a new method. The owners of water powers to-day who are considering electric transmissions can have their wants supplied by machinery of a type with which the electrical world is familiar and whose capabilities have been proven by long experience. Not that the synchronous method will not have its uses. It certainly will. Its possibilities are recognised by all engineers, and its day will come; but remember, the direct current motor has not reached its highest development. Its future is in good hands, and it will always, even under conditions most favourable to the alternator, be a competitor that cannot be disregarded.

There is another system of alternate current power transmission being developed, which has been aptly named the "multiphase method." It is a beautiful application of electrical laws, interesting to the lover of mathematics as much as to the engineer, for it has vast possibilities for analysis, and the production of graphic representations. It is not entirely new to the practical electric community. It has been applied to meters and to certain small motors.

The motors designed for multiphase currents are self-starting, self-exciting, and not necessarily synchronous, so that they are free from difficulties which attend the synchronous method. They still are vexed with impedance and hysteresis; twin enemies of alternate apparatus, but not without hope. The lines along which the development of these motors must proceed are plainly marked out, and they are certain to have their place in the future of power transmission. To-day they have no place. The brilliant experiment at Frankfort has not given us a commercially valuable method.

The absence of detailed data regarding all apparatus of this class limits me to some general observations, the first of which is that the weight efficiency of the class appears to be low—that it takes a multiphase machine much larger than the direct current machine required to do equal work. This we would anticipate from the use of the multiphase current in field magnets at low E.M.F. While the actual power absorbed is not excessive, the current out of step with the E.M.F. is very large.

The next observation is that some multiphase designers are working on the problem of conversion of multiphase to direct currents. This seems a complicated process, but may have a commercial value, and indicates recognition of the desirability of direct currents.

The last observation is that the multiphase motors, and other motors excited by alternating currents, are apparently going to make their next step toward practicability by the assistance of condensers. This will cause a development of the condenser along commercial lines, akin to that which has produced the lighting transformers of to-day from the laboratory induction coil of yesterday. And in this will be a benefit to electrical apparatus at large.

Now to examine the difficulties under which direct current machines are said to labour. First of all there is the old story, the commutator, which it is said is a source of trouble at high potentials. I have made it my business to inquire regarding the behaviour of every high potential commutator which I could hear of. The list, outside of the commutators of arc machines working up to 3,000 volts or so, is a small one, but I have heard of at least two commutators working with 5,000 volts and 10 ampères which gave no trouble, of an indefinite number of commutators working at 1,500 volts and 20 ampères which give no trouble, and of about a dozen working at 1,500 to 2,000 volts and 40 ampères, which give no trouble. The record appeared to be the same all through. The commutator did not appear to be the weak part of the machine. You see none of these machines is a very large one. The reason I didn't get data about machines with outputs greater than 75 kilowatts is that I couldn't find any such machines working at high voltages. It is only lately that there have been large dynamos put in use in this country for any purpose, though there are now many at 500 and 1,000 volts. When a power transmission needs large machines of higher E.M.F., the machines will be ready, and the commutators will not give trouble.

Then we have the objection that high potential differences must be handled in direct current machines if economy of copper is to be secured on the lines. The alternate current transformer has the advantage in this respect, in that it is a stationary piece of apparatus whose construction admits of high insulation without material reduction of efficiency. And therein lies the certainty of the future development of alternating methods of transmission. There will come a few cases when the copper in the line will be a large factor in the total cost of the plant. These cases are far between. I have ascertained the proportion that copper bears to the total cost of line construction in a number of plants employing such E.M.F as is common in direct current work. I am speaking of overhead lines now, the cheapest method of construction, and I find the percentage of copper cost is very small. Thus, in the cost of a mile of pole line, built in a workmanlike manner, with ordinary insulation, two wires being strung, the proportion of copper was 30 per cent. The remaining

70 per cent. represented poles, fittings, insulation and labour of construction. The proportion which this 30 per cent. of cost of pole line bore to the whole cost of the plant was very small. I have looked over the bills of actual expenditures on a number of pole lines, and over the estimates made by responsible contractors for many others, and I find that where a good line is built according to the idea of line construction generally prevalent in the United States, the copper is a comparatively small item of the line, and proportionately less in the whole cost of plant. But we cannot figure in power transmission work on using overhead lines, not even in the mountains, where there is no æsthetic sentiment to force the wires below the ground. The telegraph lines through the mining districts and others where water powers abound break down every winter under pressure of storms.

I need not show this assembly the visionary nature of schemes to carry the water power of Niagara to New York or Chicago. We will, any of us, undertake to do this if we receive the order from a responsible person, but we will each and all of us abstain from taking stock in the manufactories which depend on the transmitted power, and we will do this because we know that power transmitted means power lost in transmission, and that a difference of even three or four or five per cent. in the cost of power means the control or the loss of the market for manufactured goods in these days of sharp competition. The same commercial necessities which built up in the wilderness Rochester, Minneapolis, and the towns on our own Fox river, away from the markets of their product, but near to cheap power—that same commercial necessity will limit the distance to which electrical power will ever be transmitted. It is not a question of engineering. It is a question of dollars and cents to the manufacturer.

HOW ELECTRIC SIGNALS ON STEAM RAILROADS ARE ACTED ON BY ELECTRIC RAILWAYS.*

By J. H. AITKIN.

SINCE the completion of the Allentown and Bethlehem (Pa.) electric railway, the electric train signals on this section of the Lehigh Valley Railroad Company have been frequently and often entirely thrown out of action by the heavy earth currents from the electric road. These troubles began with the running of the first cars. Before the opening of the road in July no trouble from a similar source had ever been experienced.

The signals mentioned consist of a track instrument containing a mechanical circuit opener with sliding spring contacts. One contact is grounded by a wire to the rail, which is used is a return to battery. The other contact connects to an overhead line. In its normal state a closed circuit is maintained through the relay, line, instrument, track and battery. A train passing moves the lever, opens the contact and breaks the circuit. The armature drops and brings in play a local circuit and bell.

Operators began reporting the bells as ringing continually when no train was passing, or not ringing when trains had gone over. Examination proved the instruments in order and the batteries strong, and that at night, after 12 p.m., the instruments worked all right. On disconnecting the battery from the main circuit and placing a galvanometer in its place, a deflection of 15° to 30° was obtained. This earth current was sufficient in itself to hold up the armature, which it often did for an hour or more. The approach of an electric car invariably affected the circuit, either causing the armature to drop or hold too strong to signal a coming train.

At Allentown, where the electric road crosses the railroad tracks, the disturbance was greatest, the distance to the nearest intrument being not over one-quarter of a mile. One mile below this, and over a mile from the electric road, a similar condition resulted. An equal distance west the same cause was found. At Bethlehem two instruments, one half mile from the road, were similarly acted on. Heavy and light days on the electric road showed in a corresponding manner on our instruments. In some cases it was found reversing the batteries removed the trouble, in others more batteries were necessary. But singularly, with batteries on different instruments not one mile apart, one would require zinc to ground, the other copper. In two cases it was necessary to increase the strength to six cells of gravity battery, and even then reverse the ground connections.

A return overhead wire is the best solution to the problem. The rail return is still used; but by acting as above described no further trouble has been experienced in this direction.

* *Electrical World.*

RESEARCHES ON THE TRUE ELECTRO-CHEMICAL EQUIVALENT OF COPPER.

A DETERMINATION of the true electro-chemical equivalent of copper has recently been made by J. Vanni, who contributes a paper describing his investigation in the *Annalen der Physik und Chemie*, series II., vol. xliv., pp. 214—221.

The electro-chemical equivalent of copper appears to vary under certain conditions; this was established by Gray some time ago [*vide Philosophical Magazine*, series V., vol. xxii., p. 389, and vol. xxv., p. 179], who found that the magnitude of the "constant" varied at 12° Centigrade from 0·0003287 with a current density of 20 milliampères per square centimetre at the cathode, to 0·0003278 with a current density of 3·3 milliampères; and at 35° Centigrade so low as 0·0003245. It may be remembered that Gray, in endeavouring to explain this variability, advanced an observation made by Gore, namely, that the solution of sulphate of copper dissolves up a quantity of copper varying under different conditions.

The object of Vanni's investigation was to test the validity of the explanation advanced by Gray, as well as to determine, if possible, the true electro-chemical equivalent of copper. About ten pages are occupied in the *Annalen* with a description of the apparatus, the method of making the observations, and a consideration of the results; but the pith of the paper is as follows:—

Two copper voltameters, with plates of different areas, were placed in the same circuit; the surfaces varied in the proportion 4 : 1. With a solution of sulphate of copper, for example, containing 1 per cent. of free sulphuric acid, it was found that 0·1903 gramme of the metal was deposited on the larger cathode, while 0·1960 gramme was deposited on the smaller cathode during a period of three hours.

The current in this case was interrupted, and the cathodes were allowed to remain three hours longer in the solutions. It was then observed that the larger cathode had lost weight owing to some of the copper having dissolved, presumably, in the sulphate solution. The larger cathode had lost 9·2 milligrammes, but the smaller cathode only 3·2 milligrammes. If these losses be added to the weights deposited we obtain the following results:—

0·1903 gramme		and 0·1960 gramme.	
0·0092	„	„ 0·0032	„
0·1995		„ 0·1992	„

These results, differing as they do only by 3 in the fourth place of decimals, are sufficiently close, and show that Gore's explanation of the apparent variability of the electro-chemical equivalent is valid.

Vanni observed that when the contents of free sulphuric acid was reduced to a mere trace in the sulphate of copper solution, namely, to about 5 milligrammes per litre, there was no perceptible quantity of copper dissolved in the course of a two-hours experiment. Hence solutions of this kind were employed for determining what might be the true electro-chemical equivalent. With these results were obtained, the mean of which is taken by Vanni as the true equivalent of copper in cupric salts: this mean value is 0·0003284, that of silver being taken as equal to 0·001118.

ELECTRICITY FOR INTER-COMMUNICATION IN VIENNA.

[FROM OUR OWN CORRESPONDENT.]

THE City of Vienna, recently enlarged by its amalgamation with the suburbs, is now busied with the creation of improved arrangements for local inter-communication in accordance with the heightened demands made by a city of the first rank. In these arrangements a very prominent part will be assigned to electricity. The local papers write to this effect concerning the electric lines about to be created.

The local narrow railways projected to facilitate inter-communication with the centre of the city, and the radiating lines in the inner city (for which alone a concession has been granted to a private company), are to lead on the one hand from the Elisabethbrücke, below the Stefansplatz to the Ferdinandsbrücke Station, and on the other hand from the station Schottenringe, below the Freiung, the Platz Trench, the Stefaniplatz and the Wollzeile to the station at the chief Revenue Office.

As the establishment of a line within the blocks of houses is impossible, as well as in the streets of the inner city, and the construction of underground or tunnel lines of an ordinary construction at a slight distance below the level of the streets appears impracticable on account of the sewers, the gas and water mains, &c., a tram or railway in the inner city can be constructed only at such a depth below the surface of the streets that it may, by means of a suitable construction of tunnels, be carried underneath them without interfering with their use. On this account it is proposed to apply for the construction of radiating lines intersecting the inner city, a system of lines which has already been carried out successfully elsewhere under similar conditions (City and South London Electrical Subway, in London), according to which the lines having double tracks will be placed in an iron twin-tunnel considerably deeper than the sewers and mains laid down in the streets. The electric current required for working it is to be supplied to these lines from an existing central station, or from one to be especially erected.

At the termini of the two diametric lines, at their point of intersection, and at several intervening points situate conveniently for traffic, passenger stations or stopping points are to be provided. They are to be made easily and conveniently accessible for the public by stairs, or at greater depths by lifts, and it has been ascertained that the necessary space for the officials and the public, as well as for access to the stairs and the lifts, can be accommodated in the ground floors of the adjacent buildings.

A METHOD OF MEASURING ELECTRO-MOTIVE FORCES AND ELECTRICAL RESISTANCES.

THIS method, which is due to S. Pagliani, is as follows :—

The current generator, of which the electromotive force is required to be estimated, is joined in circuit with a standard wire of known resistance. A branch circuit containing a voltameter has one terminal fixed to one end of the standard resistance, whilst the other is fastened to a key which slides along this standard resistance wire.

The voltameter consists of a glass tube, closed by two taps, and contains a solution of iodide of potassium (25 per cent.), to which a little starch paste has been added. The anode and cathode consist, respectively, of a copper and a platinum wire. The diameter of the voltameter tube is 10 mm., and the distance between the electrodes 120 mm.

The resistance of the standard wire is of such a value that the internal resistance of the current generator becomes negligible.

When the measurements are about to be made, the branch circuit is so arranged that the difference of potential at its terminals is insufficient for the electrolysis of the potassium iodide solution. The key is now moved along the wire that is used as the standard resistance until it reaches a point at which a violet colouration is observable at the surface of the platinum cathode. The position of the key is carefully noted. The electromotive force of the current generator can now be calculated in terms of the electromotive force, that is necessary in order to decompose the potassium iodide solution (0·610 volt).

The measurement of electrical resistances is performed by employing a current generator of known electromotive force, and inserting the unknown resistance in either the main or the branch circuit.

According to Pagliani, this method of measurement gives excellent results, both in the case of estimating electromotive force, and also resistances.

PROF. FORBES ON THE DEVELOPMENTS OF ELECTRICAL DISTRIBUTION.

FOURTH CANTOR LECTURE.

PROF. FORBES concluded on Monday night week the series of Cantor lectures on the developments of distribution. As mentioned in the previous lecture, when using water power for lighting up a small place, or transmitting power, two distinct problems occurred to the engineer, and there were several points in each of them which required particular attention. In lighting up a country house for instance, power being derived from water, experience had convinced him that the very greatest caution was necessary, even in a case where water seemed to be always available. The water power in England was more abundant in winter than in summer; that was fortunate, because they then needed most light, but it was important whether a sufficient water supply was to be obtained in the driest time of a dry summer, and whenever there was the slightest doubt, it was, in his judgment, most injudicious to set up turbines and plant, without taking measurement of the flow of water during one summer at least. There was another more serious catastrophe which might happen, the source of supply might be frozen at a time when most light was required; this was a state of things that might happen anywhere. It would be found to be a great saving if, when introducing turbines, a small auxiliary steam plant were ready in cases of emergency; it was, of course, an additional expense to the original plant, but in many cases it would be extremely useful and most economical, especially when they considered the saving effected by the water during the greater part of the year. There was another point of economy which often had too little attention paid to it, and that was when the source of power was about half-a-mile from the place where the light was required. It was a serious thing when they came to calculate the size of the conductors required to carry the current to the house. People had too often gone on the assumption that the cables would not have to be very large, and they were eventually led to a great expense. With regard to using water power for transmission from a distance and subsequent distribution through a town, perhaps at the present moment, alternating current would perform this best, but he (the lecturer) could quite appreciate the case where the continuous current would be most suitable, and there was no reason why they could not transmit ten thousand volts by means of continuous currents, taking the necessary extra care for safety. There were two means available when using alternating currents, which were the best, one was by means of self-synchronising motors, and the other was by means of the rotary phase system of transmission. He had mentioned before, that while light alternators would not work well as motors singly, when they were working in pairs, giving off different currents in different phases, it enabled them to get over the dead centres, and such machines, though extremely light, would start with a good pull from the beginning, and would do transmission work exceedingly well. Thus two Ferranti machines would work well, both generating currents and acting as motors, whereas the Mordey alternator, which he had contrasted with it, in the ordinary way of working had a very massive rotating part, and would not start well as a motor. Here they had the curious fact that the heavy rotating Mordey machine was the better of the two as a synchronising alternator, and the Ferranti was the better when using two currents in different phases. In America the dynamos which had been used by the Westinghouse Company for generating currents for the tramway, had been fitted, in place of the

commutator, with four rings, which took off two currents, one giving a maximum when the other was giving a minimum, these being large and powerful machines had been working admirably as motors, and started with a good torque. Of course they gave off an alternating current, somewhat on the same principle as that shown by Mr. Schuckert. Coming to treat of a different matter in connection with water power, he wished to draw attention to what had been done in Switzerland in the way of utilising water power. Last summer he had the good fortune to travel through Switzerland with Prof. Unwin, the object of the journey being to study the various cases where the natural power of water had been utilised in any way for transmission to a distance. He, the lecturer, regretted that Prof. Unwin had been unable to give the course of Howard lectures, for he felt sure that at the present moment, when so much attention was being paid to the transmission question, they would have been of the greatest interest and of the utmost importance to engineering science. As they all knew, Switzerland was in the front rank as utilisers of water power, and in its transmission, whether by electricity or other means, the engineering talent of the country, compared with its population, ranked higher than that of any other country in the world. The towns of Geneva and Zurich attracted most attention. Owing to the melting of snow, the maximum flow of water in Switzerland was in summer. In Geneva, the River Rhone, where it leaves the Lake of Geneva is utilised. The fall varies from 6 feet to 12 feet. For this low fall it had been necessary to erect very large turbines. There were 20 turbines having a combined horse-power of 6,000. This was a very large work, and involved a big capital expenditure. Switzerland, however, differed from a good many other republics, in respect that money voted for any particular work was really put into it. Engineering talent, combined with strict supervision over expenditure, had enabled this work to be done, and the enormous capital invested returned a profit. The way in which the turbines are utilised was to supply motive power to the factories which were distributed through the town, the watchmaking and other industries requiring a good deal of small power. The turbines pump the water up to a distant reservoir, three miles distant, which gives a large head of water, then from the pipe connected to the reservoir, pipes are laid through the town, and the motors thus supplied. The system was extremely effective, and a valuable report has been published. He might have given valuable extracts from this report, but his reason for drawing attention to the work was not so much to give details of the hydraulic work, as to draw a moral. He would draw the moral from the way in which this source of power had been utilised for the electric lighting of the town. The electric lighting of the town was carried out by a separate company, and one might think that being so near available water-power they would have erected turbines of their own, but it was found that the terms for renting power from the other concern were so moderate, as to make it worth while to rent power and set up electric lighting works independent of any source of power. Consequently they arrived at the somewhat anomalous arrangement of the electric lighting being done by means of powerful turbines on the Rhone, pumping water to a reservoir three or four miles distant, the water from that reservoir coming back to within a few hundred yards from where it was pumped, there passing through turbines which drive the dynamos for lighting the town. At the first glance, it might appear that there was no economy in that; it might appear, also, that it would be uneconomical to put steam engines down and pump the water to a distance, and then bring the water back to drive turbines. As a matter of fact, such an arrangement was economical; the reason being that when steam engines are used direct, a great deal of the value of the coal that is burnt is lost, first, because the engines are, during a large portion of time, running light; also because the boilers are consuming far more coal for the amount of work done than they would if the boilers were continually working; so that really a case may arise where a decided economy may be effected, that is, instead of putting down a large number of boilers and steam engines, required to give off the maximum current of a given station, to use a less number of engines to pump water continually to a height, supposing, of course, that there is a suitable place in the neighbourhood for a reservoir. There were many cases in England where such a system is very economical, and in any case where economy is effected, the arrangement was an admirable one, and extremely satisfactory in working. Anyone who had seen turbines working, must have been convinced of the great facility they gave to the proper management of a central station. The space occupied by the machinery was so small, the whole was so easily regulated, and the place was so clean, free from noise, and very little attendance required. As a particular case, the lecturer cited the case of Edinburgh, where it was possible to use the heights which surround the town for collecting the water. The hill known as Arthur's Seat, 800 feet above the sea, was admirably suited for this purpose. Here was a loch (Loch Dunsappie) which contained sufficient space to hold water to supply a thousand horse-power for a couple of hours. From this, one, who was conversant with central station work, would see that there was here a means of supplying sufficient power for doing a great portion of the work of a large central station; in fact, of driving one complete central station by means of water-power to be brought from that reservoir. With the utmost facility, however, a dam could be built across a gully which was near the summit of the hill, giving a far greater height than the loch, this dam would really cost little, owing to the construction of the hill; at the same time, it would not interfere in any way with the landscape. In working a station which required a maximum, say, of a 1,000 horse-power, they did not require, on the average, more than 150 H.P. What they would have, then, in this particular case would be engines and boilers of 150 H.P. working day and night, from week-end to week-end, which would be pumping water up to the reservoir on Arthur's Seat; connected by pipes would be the turbines which would drive the dynamos. Therefore, instead of being obliged to have engines and boilers of 1,000 horse-power, they would have those of 150 H.P., thus saving an enormous amount of capital. If they used Loch Dunsappie, the only serious item to put against the boilers would be the cost of the pipes, which might amount to something like £2,000. It was, however, not only the saving in capital expenditure; there was the annual saving in the coal bill. An engine and boiler continuously pumping up the water would work in the most economical manner that engines could work. They would, by this means, obtain power with very little more expenditure than 3 lbs. of coal per horse-power, whereas in central stations they often went up to 10 or 15 lbs. of coal to the horse-power. To adopt this plan where convenient would, argued the lecturer, be very desirable. He had gone very carefully into the matter in the case of Edinburgh, and he not only hoped to see the authorities adopt it there, but trusted that some such scheme would be adopted in other towns. In working out the actual figures, he might say that the capital expenditure was very little more than half of the cost of steam plant for the whole work; in addition, would be the savings in attendance and fuel. Another source of economy which could be introduced was the employment of destructors for utilising the town refuse in towns. The lecturer then dealt at considerable length with the working of town destructors, but said very little concerning their connections with electric lighting. In concluding, Prof. Forbes repeated one or two points to which he had drawn attention, and reiterated the fact that in central station work, where the alternating current was used, the plan which recommended itself to engineers was to depart from the old lines and use low tension secondary mains all over the district to be supplied, and to have subsidiary stations with large transformers regulated to work efficiently. To use alternations of much lower frequency than anything they had hitherto used, and he should watch with interest to notice which manufacturers recognised that that was the line on which work must be done, and it would also be of interest to see which manufacturers would be ready to supply the machinery required for low frequencies when the demand came. With regard to low pressures, although he could not say that actual economy was introduced by the employment of accumulators in central stations, they were a great convenience, and if they could be reduced in price, they would be largely used for taking up the work in slack times, and also for taking up part of the work at maximum output. He advocated for this work the Planté battery, pure and simple, made in its simplest form.

"SIR WILLIAM SIEMENS" LABORATORY.

IT will doubtless be remembered by our readers that to record the scientific work of the late Sir William Siemens Lady Siemens has founded and endowed an electrical laboratory at King's College. The laboratory, which is just completed, contains steam engine, boiler, direct and alternate current dynamos, resistances, and the usual apparatus of a well equipped school of electrical engineering.

Last Friday afternoon Sir William Thomson, on behalf of Lady Siemens, formally presented the laboratory to the Council of the College. A large gathering of scientists, the heads of the college, and a number of ladies attended the ceremony.

Sir William Thomson said that Lady Siemens had deputed him to express to the Council her sincere pleasure and satisfaction in seeing the completion of the "William Siemens" Electrical Laboratory. She earnestly hoped that the memorial might prove worthy to carry out what was ever full of interest to Sir William Siemens. He (the speaker) felt something of appropriateness in being allowed to speak on the present occasion. It had been his great pleasure to know Sir William Siemens and to endeavour to follow his course, and to admire and to strive to emulate his devotedness to scientific work. Personally he had derived the greatest possible benefit from an acquaintance of 35 years with Sir William Siemens, and he was sure they all felt grateful to Lady Siemens for the feelings which had prompted her to found that laboratory. That fully equipped laboratory had been for several months the working home of an enthusiastic band of students. In one respect electrical engineering had an advantage over other branches of engineering; it had been begun on a thoroughly scientific foundation. Beginners in modern electrical engineering thoroughly knew their science before they began practical work. What had grown in several thousand years in ordinary mechanical engineering had come into existence in the case of electricity in as many days or weeks. Thus it was that this creation of the 19th century could hold its own with all the best mechanical engineering in the world. He well remembered the time, however, when the engineer saw more of the practical problems of electricity than the laboratory scientist, and when there was not a scientific man in Europe that could state as intelligibly as the young telegraph operator the measurement of insulation, or even the resistance of the copper wire to the conduction of the current. Of course they must not suppose that mathematical science and experimental science were not at the foundation, for they must ever remember the work of Gauss and Weber in connection with electrical measurement. He thought practical engineers had some reason to be proud, and they had furnished all the scientific laboratories in the world the means and appliances for defining units of measurement. They were only known theoretically before the practical man put them into operation. The speaker then referred to the application of the measurement of resistance so strongly advocated in Berlin by the Siemens Brothers, and the teaching young engineers to measure currents and the action of these. The development of the dynamo, the name given by William Siemens, was largely owing to the investigations of the Siemens Brothers. In conclusion the speaker congratulated the Council of King's College on the munificent gift of Lady Siemens.

Dr. WACE, the Principal of the college, in thanking Lady Siemens on behalf of the Council said the gift was one of a series of valuable services rendered to the college in the name of Sir William Siemens. They were deeply indebted to him for the encouragement he had given them in the development of the metallurgical department and promoting the study of metallurgy. King's College, like University College, had grown up within the last 60 years on magnificent donations. They had been brought face to face with a great crisis in engineering education and the Council were at a loss how to provide the necessary apparatus. It was then that Lady Siemens came forward and offered her gift, together with an endowment for its future efficiency. Considering the work done in the college by Sir Charles Wheatstone in connection with telegraphy, King's College was perhaps not an inappropriate home for a magnificent gift of electrical apparatus.

Dr. HOPKINSON then proposed a vote of thanks to Sir William Thomson, and the proceedings shortly afterwards terminated.

LEGAL.

Lane-Fox v. Kensington and Knightsbridge Electric Lighting Company.—In the Chancery Division of the High Court of Justice, on Tuesday, the 23rd inst., Mr. Justice A. L. Smith (sitting for Mr. Justice Romer) commenced the trial of an action by which the plaintiff claims an injunction to restrain the defendants from continuing to infringe letters patent of which he is the registered owner (No. 3,988, of 1878), granted to him for an invention of improvements in obtaining light by electricity, and in distributing and regulating the currents for the same, and in the means or apparatus employed therein; an account of the profits made by the defendants by such wrongful acts, and an enquiry as to damages; that the defendants may be ordered to deliver up to the plaintiff all storage batteries and dynamos used by them in the performance of the said wrongful acts; and that the defendants may be ordered to pay the costs of the action. The defendants are a company carrying on business as manufacturers and distributors of electricity in the districts of Kensington and Knightsbridge, and the plaintiff alleges that they have since December 3rd, 1889, infringed his letters patent by the use of secondary batteries as reservoirs of electric energy in combination with their system of distribution. The modes of distribution used by the defendants of which the plaintiff complains are:—(1) The use of the secondary batteries in combination with a number of lamps placed in multiple arc between two main leads; and (2) The use of secondary batteries in combination with two or more systems of multiple arc distribution in which one or more of the main leads are common to two or more of the said systems. The defence pleaded denies that the plaintiff is the first and true inventor of the invention described in his specification; alleges that the plaintiff at the date of the issue of the writ in the action was not the owner of the letters patent, and was not entitled to sue the defendants for alleged infringements, does not admit that the plaintiff is the registered owner of the letters patent, or that they are now duly vested in him at all; denies that the defendants have infringed the letters patent, and said that the plaintiff's alleged invention is not useful and not valid.

The Attorney-General (Sir Richard Webster, Q.C., M.P.), Mr. Fletcher Moulton, Q.C., M.P., and Mr. J. C. Graham are retained as counsel for the plaintiff; Sir Horace Davey, Q.C., Mr. Finlay, Q.C., M.P., and Mr. R. W. Wallace are counsel for the defendant company.

The ATTORNEY-GENERAL, in opening the case, said this was a patent action of very great importance, and of very great interest; but he was glad to tell his Lordship it was not very complicated or at all difficult from the scientific point of view. He did not mean to suggest that if it were difficult and complicated, his Lordship would not be competent to deal with it; but there were patent actions and patent actions, and this one was not very difficult. It related to a new and improved system of electric lighting, and he would, as far as he possibly could, explain what was the existing state of knowledge, and what the patentee (Mr. St. George Lane Fox) disclosed. It would probably be better if he made his statement quite complete, and did not assume anything with regard to his lordship's information upon these matters, because it would be better to make his statement self-contained, even at the risk of saying what his lordship was aware of. Prior to the year 1878 there had been many attempts at electric lighting, but they had been more or less unsuccessful in consequence of the difficulty which had arisen in finding a useful and a commercial incandescent electric light—a lamp of the character by which the court in which they were was at that moment illuminated, which was established as being a new and improved form of lamp in the long litigation in which Mr. Edison was the plaintiff. Prior to that time it had been well known that they could light by electricity by arc lights, consisting of two pieces of carbon kept at a certain distance from each other, and the electric current leapt across (or rather appeared to leap across) from one pole to the other. These were the class of lamps his lordship saw many years ago in Paris, and which subsequently illuminated the railway stations of this country, and other places—large power lights. There was the intermediate stage of lighting by which the Thames Embankment was lit a great many years ago before these incandescent lamps were invented—the Jablochkoff candle—two strips of carbon separated by a strip of plaster of Paris and gradually consuming away. The Jablcchkoff has been called a betwixt and between—between the proper arc light and the incandescent. The electric current could be generated in a variety of ways, notably in two ways, either by primary batteries or dynamo machines. The primary battery consisted of some chemical arrangement where, by the electro-chemical action, a current was generated. He mentioned that to dismiss it, because for no practical system he had to deal with had the primary batteries entered into consideration. He did not mean to say they could not be used. The other method of producing electricity for the purpose of lighting, or in any quantity for similar purposes, was by a dynamo or generating machine. [A dynamo consisted of one piece of metal revolving in front of a permanent or electro-magnet. An electro-magnet was that which was only magnetic when the current was passing through it. But for the purposes of his description it was sufficient to say that a dynamo machine consisted of one magnet revolving very rapidly in front of or across the poles of another magnet.*] In order to get a sufficient amount of electricity, in all practical systems that dynamo was driven by water or by steam power. They might assume that in nine cases out of ten the power that drove the dynamo would be steam power. Therefore it was known at that time that a current of electricity needful for lighting could be generated

* This is actually the description of a dynamo as given in the printed evidence.—EDS. ELEC. REV.

by driving a dynamo at sufficient speed to send the current through the conductors. The conductors might be either continuous insulated wires going out and home, so that the current went right through the wire and came back again through the insulated wire, or on the other hand (and they now came to a point of very great importance) at the further end the conductor might be sent to earth. "Earth" was a technical term known to electricians as any means of communicating or completing your circuit by an uninsulated conductor. Having got the current generated in the conductor, it was necessary to fit in the lamps; and the way in which the lamps were proposed to be fitted in all systems of this time was by means of what we called the multiple arc. Each of these little arcs formed a bridge, and through this bridge, or across it, the current got back again to its destination. (The learned counsel here drew a rough sketch, which he handed to the Judge, to make his meaning clear.)

Mr. JUSTICE SMITH: What is the advantage of one over the other?

The ATTORNEY-GENERAL said it would be found that instead of the lamps communicating with another conductor, they could all go to earth. This went to the question of safety, from the Board of Trade point of view, or disturbance of electrical instruments in proximity. That would be spoken to by the most skilful electricians. The Board of Trade expected one to have a insulated conductor going all the way. But that had nothing to do with this invention. By the modern and improved and developed systems, the return was by an insulated conductor; but this was absolutely of no importance with reference to the invention he was about to describe. The system of lighting was useful, and, from an inventive point of view, complete, if all the conductors were taken to earth. His Lordship would find it was a point of importance, and perhaps of attack, from his learned friend's point of view, when they got to the specification; but he should put into the box electricians of the greatest experience, who would tell his Lordship that, from a practical point of view, it made no difference, so far as the illumination was concerned, so far as the efficiency of the system was concerned, whether these tiny wires were taken through a gas-pipe to the ground, or went back through another insulated conductor. That was the general outline of the system of working which his Lordship would have to consider most carefully, namely, a generator, a main lead—that main lead communicating with any number of branches—and a return passage connected with the earth. It made no difference, from the point of view he was about to present presently, which course were adopted. He had now to call attention to another well-known fact at this time. There were known for many years before 1878 things which were called secondary batteries. His Lordship would remember he had mentioned primary batteries as developers of electricity analogous to dynamos or generators. Secondary batteries were batteries which stored up electricity and gave it out again when required. They were an invention of Planté, and were perfectly well known for years before 1878; but, strangely enough, people imagined—what they have now found out to be quite incorrect—that Planté's batteries were not sufficient to do the work, and that some improvements with regard to Planté's secondary batteries were necessary before what he was going to describe could be done. He must introduce Mr. St. George Lane-Fox, who, it would not be denied by any witness, was an electrician of very great capacity and ability, and of extraordinary foresight. This was not the proper place to discuss the eminence or brilliancy of Mr. Lane-Fox's electrical achievements, but it was most important that his Lordship should know that Mr. Lane-Fox was no mere outsider who had imagined something that could not be worked, but was unquestionably far in advance of his time with regard to what he discovered as being practicable, and that both from experiments and actual uses, Mr. Lane-Fox knew what he had told the court in theory, and he now proceeded to obtain that which he (the Attorney-General) should prove to be the first practical system, and the first practical means of successful electric lighting. The one thing that was necessary was to keep a constant current going through the lamps. His Lordship would hear a great deal about "volts" and "ampères." "Volts" were the measure of pressure. These lamps might be 80 or 100 volts. Lamps of 50, 80, or 100 volts were lamps that were designed to carry a current of that pressure. If they required a current of a lower pressure, as a rule they required more volume. The measure of volume was by what were called "ampères." But whatever the lamp were designed to carry, that pressure or strength must be kept constant in the main leads. He would tell the court why. The filaments were made of carbon, and if you had a lamp filament (notably carbon) designed to carry a current of 100 volts and you put 120 volts on it, the lamp would break down at once; the current would be too strong, and the bridge would be broken down by the pressure. If you took it too low, the thing would not go at all. He was applying that to carbon lamps. The lamps in Court were going down (he had not arranged for that practical illustration), which meant that the lamps, or filaments, which looked red hot, had now only a portion, say 75 per cent., of what their original voltage was. There were two reasons why the current had to be kept constant: one was that the lamp might not break down from excess, the other, that the lamp might give a proper illumination from the current not going too low. Mr. Lane-Fox conceived this idea, that if he interposed in his circuit between the generator and earth—or, as he described it, between main and earth, which was the same thing—that would be somewhere before the whole current got back again; if he put in some secondary batteries he would get a constant current so far as pressure was concerned. It was better to use the word pressure when they were dealing with volts. It was not saying too much to say that that discovery of Mr. Lane-Fox's had solved the difficulty of electric lighting; it was not saying too much to say — as skilled electricians would tell the Court—that, remarkable as it might be, every system of modern successful electric lighting which proceeded from generators or dynamos, and which was absolutely maintained at a constant pressure without either what he might call automatically maintained or other devices for keeping the current constant, was an exemplification of Mr. Lane Fox's system. [The learned counsel here handed in a copy of the specification as altered by disclaimer.] The defendant company alleged that the complete specification was not in conformity with the original, that was one of the points they were going to take. The provisional specification was left by the plaintiff at the office of the Commissioner of Patents on October 19th, 1878, and the plaintiff said his invention consisted of improvements in obtaining light by electricity, and in conveying, distributing, measuring, and regulating the electric current for the same, and in the means or apparatus employed therein. In order to produce a light, he passed the electric current through thin leaves or foil of some suitable material, for which purpose he preferred to use platinum, or an alloy of platinum and iridium. That was to say, it was an incandescent lamp in which a conductor was made to glow by the current passing through it. In incandescent lamps there was always a vacuum, or else the conductors would burn up by reason of combustion taking place. The plaintiff went on to say, "The way in which I work a number of these lamps is as follows:—From one pole or electrode of the electric generator (or generators) proceeds a large conductor from which branch out at various points where lights are required, smaller conductors which again may have conductors branching off from them and so on. The other pole or electrode of each electric generator is connected with the earth, so that the conductor and its branches and sub-branches will be perpetually in a state of electric tension tending to develop currents in every direction to the earth.

Mr. JUSTICE SMITH: In what way does that arise?

The ATTORNEY-GENERAL said it did not arise in any way, unless the defendants suggested that a return to earth did not make the system Mr. Lane-Fox had described a workable system. "One pole of the electric lamp was connected with the earth, and this may be conveniently effected by means of gas or water pipes, where such exist, so that wherever the circuit is complete between the earth and any one of these branches, a current of electricity will pass through the thin leaf of metal rendering it incandescent, and so produce light. The electromotive force of the electric conducting mains should be kept as nearly as possible constant, say, at 100 volts, or British Association units of electromotive force." One hundred volts was what was now used. "A number of Planté's (lead and sulphuric acid) cells joined together in series between the mains and the earth will serve as a kind of reservoir for the electricity." It would be contended by the other side that that prevented Mr. Lane-Fox from saying that he used his secondary batteries as regulators, because they would say he was indicating another kind of regulator. But it would be conclusively proved that the regulator he was referring to was a regulator for keeping the steam which drove the engine constant, or to keep the amount of current which came from the generator free from the fluctuations which would depend upon different pressure of steam. If it were attempted to be said that secondary batteries were not regulators because Mr. Lane-Fox said it was necessary to have some regulator such as that about to be described, it would be proved that the regulators described had no relation to the function performed by the secondary batteries, but were regulators which had to do with the keeping of the pressure, whereby the dynamos were worked, constant. On July 30th, 1883, a disclaimer and memorandum of alteration was entered by the plaintiff, and the defendant who said that the invention claimed was substantially different from that claimed by the original specification. The plaintiff then said, "My invention consists of improvements in distributing and regulating the electric current for obtaining light by electricity." He had to make his complete specification self-contained, and he cut out the claim where there was any suggestion of the thing being misleading. The plaintiff said, "The cells should have a very large conducting surface, and there should be several batteries connected up at various points of the mains, so that by increasing the electromotive force during the hours when not much electricity is being used, they will become charged, and the electric force will be stored up in them, so that a sufficient supply will be available when the electromotive force falls owing to the draught from the mains when the force is most used and needed. The number of cells,"—and this was very important—"in each of these batteries will depend upon the electromotive force of the mains." This was a unique declaration as to the use of the secondary batteries. All kinds of publications were suggested by the defendants in this case, who alleged that Mr. Lane-Fox told the people no more than they knew. But he (the Attorney-General) asserted, on his instructions, that it was a unique enunciation of the utility and function to be performed by secondary batteries. The complete specification went on—"Fig. 5 is a diagram representing a secondary battery joined up between the main and the earth, for the purpose described. In order to keep the electromotive force in the electric mains constant, it is desirable to have, in the first place, several generating machines; also a number of reservoir batteries, as before explained." Wisely advised, Mr. Lane-Fox threw over everything which it could be said might have involved other considerations than the use of the secondary batteries. His lamp (though a good one) was nowhere in connection with the carbon light of Mr. Edison. He was not there to consider whether Mr. Lane-Fox had not almost as much merit as Mr. Edison with reference to the production of that. The iridium lamp was beaten out of the field, and Mr. Lane-Fox disclaimed it. A regulator for regulating the steam was found not to be essential, and accordingly that was thrown overboard. Everything was cut out but the one essential novelty, which was the employment, as described, of secondary batteries. "In order to keep the electromotive force in the electric mains constant, it is desirable to have, in the first place, several generating machines; also a number of reservoir batteries, as before explained." His Lordship would

wonder why, this having been patented in 1878, they were fighting this case in 1892. Mr. Lane-Fox would tell the whole story. It was the fact that Mr. Lane-Fox was not a rich man, and had not before been able to find the funds to fight against the combined interests that were against him. A full explanation would be given of any point. Mr. Lane-Fox could not get his injunction because of the delay which had taken place, but he was there to prove by his evidence its absolute utility and (according to his instructions) the declaration of the new system, which was a great invention which had been universally adopted. He (the Attorney-General) was told by those who would give evidence that if with the knowledge they had in 1892 this specification had to be written out again, it would be written out in practically the same words. In this system the return was by earth. In the systems that had been used since the return was by an insulated conductor. The important issue upon that was: Was that a fundamental distinction or not? Electricians of independent position would tell his Lordship that it was known in 1878 as an alternative return, and that from the point of view of merit and utility of the invention it made no difference whether you had an insulated return or an uninsulated return; whether you come back by earth or by an insulated conductor. If that turned out to be immaterial, that distinction disappeared. The Court had nothing to do with Board of Trade regulations. He (the Attorney-General) did not even know they existed. An improvement would not cease to be an infringement because it was an improvement, unless it separated from the principle described in the invention. That had been laid down as the law over and over again. If it were suggested that without altering the character of the invention the insulated conductor was an improvement, he should be able to show that would not prevent it from being an infringement. His Lordship would find allegations of prior publications from eight or ten different people. He was not going through them now. It was for the defendant to establish anticipation. In the last lamp case, Mr. Justice Kay went so far as not to allow the plaintiff to refer to earlier particulars, but insisted on the defendant doing it. From beginning to end of these publications, as he understood (on the instructions of his witnesses), there was not a reference to this system of lighting or to anything analogous to it. Then there were amendments, and (he could not help thinking for the purpose of embarrassing) fifteen more allegations of insufficiency in the plaintiff's specification were added. The plaintiff's electricians would deal with that, and they would tell the Court that the whole of them were simply stating that which was well known at the time, and alleging the specification of that to have included common knowledge. There was only one other question. As to what the difference was there was no dispute. The defendants used generators; the plaintiffs used mains running out. The defendant's took the plaintiff's identical combination, save and except their return was an insulated one, instead of an uninsulated one. The plaintiff's witnesses would tell the Court that that in their judgment was a direct infringement of the plaintiff's patent. The construction of the specification was for his Lordship, and (if the evidence stood as he had opened it) he should ask him to come to the conclusion that the defendants had, if anything, only improved on the plaintiff's specification, and had improved it from a point of view which was common knowledge at the time the plaintiff's specification was filed. He said the only improvement of the defendants was that of having an insulated conductor, and, if that had no effect upon the electric working of the system, that did not prevent it from being an infringement. That was not an improvement in patent law, though it might be an improvement commercially. The thing was what the plaintiff had described, and if the defendant had taken what the plaintiff had described, though he had improved upon it, unless he had made it successful from the electrical, mechanical, or chemical point of view, it was equally an infringement. If the defendants' were merely an improved return as compared with "earth" return, the authorities were overwhelming that this was an infringement. The defendants now used one outway conductor and two return conductors. This was called "the three-wire system," that was to say, the pressure on the conductor going out was 200 volts, and the pressure coming in came back through each of the hundreds. He did not think his learned friend would contend that that made any difference. He was told by electricians that it was merely an alternative method of using a 100-volt current.

Mr. FINLAY: I agree.

The ATTORNEY-GENERAL concluded by saying that the case depended entirely upon the electrical evidence as to the state of knowledge and as to the sufficiency of the specification, the construction of the specification (which would be for his Lordship), and what the defendants would be able to prove. Mr. Lane-Fox had to fight a combination of electric lighting companies who had declined to recognise his rights, and he was sure his Lordship—having regard to the importance of the case to Mr. Fox—would give close attention to the case, the brief outline of which he had endeavoured to put before the court.

Prof. JOHN PERRY, Fellow of the Royal Society, Doctor of Science, Master of Engineering at the University of Dublin, Professor of Engineering at the Finsbury Techical College, was then examined by Mr. Graham as follows:

Have you had great experience in electrical engineering prior to 1878?—Yes, the study and teaching of electricity has been my profession for many years.

Have you read the plaintiff's specification?—Yes.

Describe shortly what the invention is so far as you find it there claimed?—The employment, as described, of secondary batteries as reservoirs of electricity in combination with the mode or system of distribution such as is described in the specification. The system of distribution is that of distributing electric energy to incandescent lamps in parallel from dynamo machines. All these lamps come in parallel from the main lead to the earth lead.

Will you explain in what way secondary batteries affect the working of the system?—The secondary battery prevents flickering of the light; that is to say, it regulates the supply when the dynamo is in use. When the engine which drives the dynamo goes a little too fast so that the pressure becomes too great for the lamps, the battery stores the surplus of electricity. When the dynamo goes too slow the light will flicker, and the battery unstores, helping the dynamo.

The surplus energy of the dynamos first flows into the batteries, and then flows out when required?—Yes, it is an automatic regulator.

Do you consider that the invention there described was novel in 1878?—Certainly.

And will work exactly as it is there described?—Yes.

The invention has been very much used?—Yes, very much.

In your opinion is it a useful invention?—Yes.

Have those batteries any effect in keeping the pressure in the mains constant?—Yes, they keep the pressure steady. They act as regulators.

Is that compensating effect an important one?—A very important one.

Prior to 1878, Planté and others had frequently described the use of these secondary cells in certain ways?—Yes; but I do not know any description other than Lane-Fox's patent of secondary batteries, and the purpose of compensating the tendency to variation of the pressure on the main.

Mr. JUSTICE SMITH: What were secondary batteries used for before 1878?

WITNESS: Producing momentary effects. Effects were produced of a striking character initially from a small number of primary cells. They were used to produce certain momentary large effects, such as melting wires, producing great noises and shocks, and for laboratory apparatus, but not for compensating the pressure from dynamos.

Mr. MOULTON: It is only they stored up the use of primary batteries for a long time, and then let them off like a gun.

WITNESS: It was like drawing a bow. They did it slowly, and let it off suddenly.

Mr. GRAHAM: That was the character of the use to which plaintiff's cells had been put?—Yes.

Besides placing these lamps in parallel, do you find in the plaintiff's specification any other conditions for the successful working of the patent?—Yes, he describes the kind of lamp which must be used.

Mr. JUSTICE SMITH: That is an incandescent lamp?

WITNESS: Yes. He describes one form of such lamp—his own form.

Mr. JUSTICE SMITH: I thought the lamp was given up.

Mr. GRAHAM: Yes, because Mr. Edison's lamp is very much better.

WITNESS: It satisfies the conditions better than Lane-Fox's own lamp did.

Mr. GRAHAM: What are the conditions you find in Lane-Fox's system which are meretorious? Did you find Lane-Fox drew attention to what was the desirable voltage?—Yes, he points to a fairly constant voltage. (Page 4, line 47.)

Does he indicate a system of distribution strictly analogous to the distribution by water through mains?—Yes. Before his time the idea of distributing electricity as gas and water are distributed was quite unknown and foreign to electricians. After I had heard of this system, I did not believe it would work—this was about 1878—until I had carefully considered all Lane-Fox's instructions.

Had "earth" a technical meaning in 1878?—It was a technical term for a return: "metal" returns were usually called "earth."

Have you read what the defendants allege are anticipations of the plaintiff's patent?—Yes; but I do not consider they are anticipations.

With regard to the infringements. You have been to the defendants' place at Knightsbridge for the purpose of inspecting what they were doing?—Yes.

Does that sketch represent correctly (diagrammatically) what the defendants are doing?—Yes; except as to the number of cells. [The sketch was handed in and marked as an exhibit.]

Is the arrangement shown in that sketch in your opinion an infringement of what the plaintiff claims?—Yes.

In cross-examination by Mr. FINLAY, WITNESS said that the advantage of Mr. Lane-Fox's patent was that it would prevent flickering. The patent also pointed to the storing up of electricity during the day-time for use at night when a greater supply of electricity was wanted. Mr. Lane-Fox, in his drawings, showed such a connection of batteries with the mains as must have prevented flickering. The use of "reservoirs" was spoken of, and the natural use of reservoirs was to prevent flickering: the fly-wheel on an engine was a reservoir of energy. In the year 1878 the word "earth" had a well-known technical meaning which included all conductors, insulated and uninsulated. When in May, 1882, Mr. Lane-Fox, reading a paper before the Royal Institution, said that "returns from earth includes all conductors in which the conductor was uninsulated," he included conductors which were insulated. In the present state of electrical science, he would not use the word "earth" as a return for a uninsulated conductor, but it was a correct use of the term (and one used by himself) in 1878. "Earth" was at that time used as including insulated conductors. He knew that the defendants used an insulated conductor, and that it was important to make out that in 1878 "earth" would include a conductor such as the defendants used. He would undertake to show that by reference to books on electricity of that period, and he was afraid Mr. Finlay was being instructed by persons who had learned electricity very recently. The system of lighting in parallel was not, so far as he knew, known before 1878, though one or two lamps were made for laboratory purposes. Jablochkoff's system, which was in 1877, did not convey to his mind by the drawings that it was intended that the lighting should be in parallel.

Mr. JUSTICE SMITH intimated that he did not think there was much in this point.

WITNESS having admitted that Planté's battery was an old one, was asked by Mr. FINLAY:—

What novelty is there in applying Planté's battery to these purposes, which were the purposes for which it was invented—the storing of electricity.

The WITNESS: This was a different kind of storing.

Where is the novelty in using in another connection Planté's invention?

The WITNESS: Planté had never used it in this way, nor anybody else.

Then even Planté himself would, according to your construction, be shut out from a possible application of his own battery?

The WITNESS: In this way, certainly. Andrew Melville Clark, a previous patentee, employed a secondary battery in connection with electric bells, but his application was for producing temporary effects only. The plaintiff's process was more than a new application; it was a distinct process. Planté and Clark used the battery to store energy, and they could keep their store for a long time if it were only used now and again, but they could not use it continuously. The plaintiff's invention was an application of a known reservoir to a particular object. Orchard used Planté's battery for improvements in railway brakes—a totally different purpose. Asked as to the practicability of working the system as described in Lane-Fox's patent, witness said that if a secondary battery were wanted which could be relied upon for 100 volts, an electromotive force up to 125 volts would not be wanted to effectually charge that battery—101 volts would be sufficient. He had made experiments which showed that. The higher the voltage, the more quickly the life of the lamp would be brought to a close. In 1878 it was necessary for the working of Mr. Lane-Fox's patent to have such a system of regulation as was described in his original specification.

Mr. FINLAY said that that mode of regulation had since been disclaimed.

Mr. JUSTICE SMITH asked why, if the regulator here described was necessary in 1878, it was not necessary in 1883.

WITNESS said because engines and dynamos ran better and more regularly in 1883 than in 1878. It was *desirable* to have the regulator, but it was *necessary* to have the accumulator. It had not been found absolutely necessary in practice to regulate the amount of electromotive force from the dynamos to avoid smashing the lamps, because he knew systems in work without it. Automatically, as described by Lane-Fox, the system would work very well. It was applied to part of Glasgow University about 1882, and he (witness) used it in lighting the dining-room of the Grand Hotel, Charing Cross, in 1883.

At this stage, the further hearing of the case was adjourned until yesterday, in consequence of several of the leading counsel having to appear before the Privy Council.

Allison v. City and South London Railway.—The case of Allison *v.* the City and South London Railway Company came again for the fourth time before Mr. Justice Kekewich, sitting in the Chancery Division of the High Court of Justice on Tuesday last. It will be remembered that the action was brought by the trustees of the Stockwell Orphanage to restrain the defendant company from so working their dynamo engines at the Stockwell terminus of the line as to be a nuisance to the occupants of the orphanage, by smoke, condensed steam pouring on the windows, vibration, and noise; and that defendants having adopted means for lessening these complaints, the learned Judge directed that an expert, in the person of Mr. H. G. Harris, a gentleman in the office of Sir Frederick Bramwell, should see the premises and engines, &c., and report thereon. Accordingly Mr. Harris now attended, and put in and read a detailed report of a series of visits he had made to the orphanage and the company's engine house, his conclusions on certain questions left to him by the learned judge being that the engines cause such noise and vibrations as to interfere with the ordinary comfort of those occupying certain rooms in the orphanage; that everything had not been done which reasonably could be done to prevent such interference with the plaintiffs' rights, and to carry on the defendant's working with less vibration. In answer to Mr. Renshaw (counsel for the plaintiffs), Mr. Harris said he was not prepared to suggest which was the best place for the company's engines, &c.; he was only prepared to say the present was not the best either for the company or the orphanage. In reply to the Judge, he further said that the company could put their engines so as to be from 20 to 30 yards from any habitation, but whether that would be satisfactory for the company's working he was not able to say. Mr. Cozens-Hardy, Q.C., then dealing with the case from a legal standpoint, submitted that the company was authorised by Act of Parliament to carry out the work in which it was engaged. It might be that the work had technically become a nuisance, but legally it was authorised. The Act of Parliament relieved them from liability, unless it could be shown that they acted negligently. At the close of the arguments, his Lordship laying down the guiding principles which he had to consider in the case, said the question was, did the Act of Parliament give the company power to do that which they claimed, notwithstanding that it created a nuisance. If he found there was a nuisance created, he had next to consider whether they had done all they reasonably could to prevent complaint. Passing these two points in review, he came to the conclusion that the Legislature had sanctioned what turned out to be the means of creating a nuisance; and as to the cure, both parties had done their best, the one to suggest and the other to carry out a remedy. If there was no other means of congratulation in this case, he thought there was ground for satisfaction in having called for a report from Mr. Harris, and having the advantage of his inspection and consideration of the whole matter. The result seemed to be that, after all that had been done, there still existed an intolerable nuisance, and he was afraid that its diminution was not very large or felt in a sensible degree. The company having selected the site for their engine-house—not arbitrarily, but as the most convenient to them—there was ample authority for holding that they were acting within their limits. They had done, he thought, much in the direction of carrying out all that could reasonably be required of them. He hoped they would continue to do all in their power to prevent this intolerable nuisance. In view of all that had transpired, he thought they must pay all the costs down to, say, December 31st last, and also a sum as damages—not a large amount, but, say, £50. The costs of Mr. Harris would be divided between the two parties, and plaintiffs would pay one-half of that figure, beside all their own costs.

PARLIAMENTARY NOTES.

THE RAILWAY COMPANIES AND THE TELEGRAPHS.

Mr. JOHN ELLIS asked the Postmaster-General on Monday night in the House of Commons whether his attention had been drawn to the remark in the report of the Select Committee on Revenue Estimates of July 11th, 1888, as to the loss to the State from "the enormous increase of services gratuitously performed for the railway companies" by messages so sent under a contract made in 1870, and also to the reference made to this matter by the late Postmaster-General in Committee of Supply on July 23rd, 1890, and whether he could now say how the matter stood as between the State and the railway companies.

Sir J. FERGUSSON: This matter has for a long time received the anxious consideration of the Post Office, and we have been during the last few months in communication, by meetings and correspondence, with the representatives of the railway companies. No arrangement has yet been arrived at, and the last communication was from the Post Office. In the meantime I am glad to say that the growth of the loss in question appears to have been stopped.

SALARIES OF TELEGRAPHISTS.

Mr. MCCARTAN asked the Postmaster-General whether he was aware that certain clerks of the Central Telegraph Office received £116 a year in the first class after a service of ten and a half years, and other clerks with services of ten years and five months, and ten years and four months only received £86 a year in the second class; whether the difference of salaries arose solely from the classification system; and whether, considering the grave discontent which that inequality was causing in the service, he would inquire into the matter in order to have it remedied.

Sir J. FERGUSSON: The statement made in the first paragraph is literally correct. In 1890, in connection with the general revision of the indoor establishment of sorting clerks and telegraphists, a large addition was made to the first class of telegraphists at the Central Telegraph Office in order to provide for duties proper to that class, and the new appointments thus created were filled by promotion from the class below. The promoted officers were fortunate in obtaining such a material increase of pay, but, of course, this good fortune involved no hardship upon their colleagues left in the second class, and who, when their turn comes for promotion, will enjoy a similar advantage. Those in receipt of salaries of £86 a year are by no means at a standstill, as they rise by increments of £6 a year to the maximum of the class—£110 a year. Seeming inequalities such as the hon. member indicates must generally follow the re-organisation of an establishment, and there is nothing exceptional in the case of the Central Telegraph Office which calls for a resettlement of the costly revision granted, after full and careful consideration, little more than a year ago.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers, February 18th.

(Authorised Abstract.)

MAJOR CARDEW showed an electrometer method of testing high insulation resistances. A water battery of 400 copper-zinc couples is connected to the two pairs of quadrants and the needle to earth (only two quadrants are shown in figure), the whole of the rest of the system being very highly insulated from earth. If the middle cell be now touched with an earth wire the needle will come to zero position. One quadrant is now joined to earth through the insulation to be measured, and the other through a known variable resistance, the latter is then varied till a balance is obtained. The variable resistance used was a cord partly silk and partly cotton, which had a resistance of 2,500 Ω per inch, one end was attached to the quadrant and the other to a point several feet away, the resistance being varied by moving an earth wire along the cord till a balance was obtained. The same idea may be used for keeping a continuous check on the insulation resistance of high E.M.F. mains, fig. 2, the two wires being joined to the two quadrants and the needle earthed. As long as the latter is at zero, the insulation of both mains is the same, while the actual resistance may be calculated from putting one or other to earth through 100,000$^{\omega}$ and noting the deflection.

Mr. ROBERTS, of the G.P.O., showed the apparatus used there for testing rubber for durability. He mentioned that analysis had shown some samples tested, to be adulterated with French chalk, pitch

resin, asphalt silica, and old rubber. The samples were tested dry in a small copper oven, heated by a gas jet to 220° Fah., and wet in an ordinary dentist's vulcaniser also heated by a gas jet. This was half filled with water, the samples were placed in it, the top fastened down, and a safety valve on the top set to blow off a 90 lbs. pressure which corresponds to a temperature of 320° Fah. The apparatus cost from £3 to £4. Samples which had passed these tests were shown, and also some which had failed.

Mr. GRAY thought Mr. Preece was mistaken in saying that engineers did not pay attention to the lasting properties of insulation in cables, as he thought they were fully alive to its importance. The figures given in the Silvertown lists were, he said, merely the minimum values. As the size of cables increased, the thickness of insulation also increased, but not proportionately, and consequently the insulation resistance per mile was less in the larger sizes. He wished that some standard time of electrification could be agreed on in testing. One minute was most usually adopted, but some makers allowed five minutes. He believed in using high battery power for tests; it broke down faults, but did not injure good cable. He considered that sparking distance in air had no bearing on the thickness of insulation required. Durability he considered to be in no way

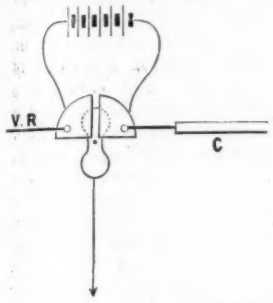


FIG. 1.

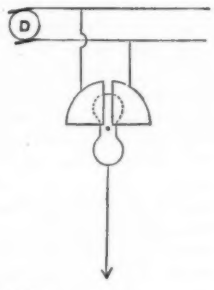


FIG. 2.

V R, Variable Resistance; C, Cable.

CARDEW'S HIGH RESISTANCE MEASUREMENTS.

dependent on initial insulation resistance. He had a cable tested every fortnight for five years, which began with nine (Preece) units of insulation, and remained at the same figure still; another kept perfectly steady for the same time at six units, while a third, which began at four, had fallen to ·4. Some high insulation cable would, moreover, spark through, at an E.M.F. which would not break down other cables of lower resistance. He did not consider that the heat tests applied by the G.P.O. were by any means infallible. He had with him some samples of rubber which he had received from America. They were made from old ground up goloshes, but they would pass the G.P.O. heat tests perfectly.

Prof. FORBES said he was startled to hear Mr. Gray's last remark, but still thought that the test was a step in the right direction; even if all that passed it was not necessarily good rubber, it, at any rate, detected a good deal that was bad. He objected to Mr. Preece's statement that specific insulation resistance was not mentioned in specifications; a resistance of so many megohms per mile when the diameter of core and thickness of covering was given, defined the specific resistance perfectly; but he agreed that Mr. Preece's method of expressing it was much more convenient. He quite agreed that high insulation resistance was no criterion of durability. He did not believe in basing the thickness of insulation on the sparking distance in air, as this only came in in the case of a crack. Bad cable would crack, however thick the insulation, and a cracked cable was always dangerous. The proper thickness depended on mechanical considerations only. He believed the safest thing was to go to a manufacturer with a good reputation, and to trust to his not risking losing it by turning out bad work.

Mr. CROMPTON thought that Mr. Preece's specification would not mend matters much, and would prefer to trust to a maker's reputation. He considered the Board of Trade requirements quite insupportable. He had cable which passed all their requirements except thickness of insulation, which was better covered, and he considered much safer and more durable, than what they would pass. The latter, with its thicker insulation, was far more liable to kink and crack. To fulfil the Board of Trade requirements, makers would have to supply inferior insulating material on account of excessive cost. Engineers ought to combine to make a firm stand against the thickness required by the Board of Trade. What was wanted was a thin covering of the very best material and make. Such a cable would never crack.

Mr. RAWORTH said it was rather a shock to hear that high insulation resistance was no proof of goodness. Referring to the numbering of cables, he said that at the Brush Company the wires were called according to the section in thousandths of a square inch, *e.g.*, $\frac{23}{1000}$ths was No. 23. The number gave, therefore, the current the cable would carry at 1,000 A per square inch, and the number × 40 gave yards to the ohm. For alternating work he found a useful formula for leads was 2,000 Y on 2,000 yards of main, allowing two per cent. loss in mains means 2 lbs. of copper for every two lamps.

Mr. SIEMENS referred to the influence of E.M.F. used in testing insulation resistance, and gave the following results:

	R. with 100 cells.	R. with 1,200 cells.
Gutta-percha core ...	3,468 Ω	3,021 Ω
India-rubber core ...	8,054 „	6,245 „
Lead covered cable ...	2,800 „	1,708 „
Do. ...	2,600 „	2,200 „

High E.M.Fs. did not necessarily affect the insulation resistance of a cable, as he had some which was in daily use during the Frankfort Exhibition at 30,000 volts, and which came back with the resistance unaltered.

THE TELEPHONE QUESTION.

A SPECIAL general meeting of members of the London Chamber of Commerce was held in the Council Room on the 22nd inst. for the purpose of discussing the general position of the commercial community in regard to the telephone service of London and the telephone Bills now before Parliament. As will be seen from our report, Sir Albert Rollit, M.P., occupied the chair, and in a few clear remarks expressed views which will obtain general acceptance as to the position of the telephone service in relation to the commercial community. The other principal speakers were representatives of the National Telephone Company, the New Telephone Company, who contemplate the establishment of a competing system, and the Mutual Telephone Company, now working in Manchester.

The members of the London Chamber of Commerce very naturally, and very rightly, encourage competition. It is their interest to do so; as it is also the interest of those who, like ourselves desire the expansion of electrical enterprises and the consequent widening of the area of technical employment. Competition leads to increased activity, and good must come from an accession of well-directed activity in the London telephone service, as in anything else. For such reasons the citizens of London and ourselves should heartily welcome any new comer to the ranks of the telephone service. But we do not deceive ourselves, and the commercial community of London should not deceive themselves either, that competition in telephone exchanges is not comparable with competition in any other business; and furthermore, that no advantage in the long run is to be obtained from a competition deficient in strength, or a service defective in its inception. We recently had occasion to criticise the means proposed by the New Company, and to express the opinion that there were grave doubts of their doing what was claimed for them. Our criticisms have been met in a manner which, in itself, materially increases the gravity of the doubts and decreases the reliance to be placed on the claims made.

We have insisted and we do insist that no good is to be obtained by under estimating either the difficulties of the problem or the cost of the service. The difficulties are not to be overcome by assertions, nor the cost defined by promises. For these reasons we regret that the representatives of the New Company should apparently still make light of difficulties which are unquestionably great, and still make promises based on estimates which experience may prove to be inadequate.

When it is understood that the telephone business is a serious business, and needs to be seriously met; some advantage is likely to accrue. Until this is understood, the commercial community of London would do well not to place too much reliance on promises based on estimates of which the details, so far as they have been submitted to public criticism, are wanting in the precision necessary to the successful carrying out of any engineering undertaking.

An Idea for the Columbian Exhibition.—It is reported from America (this is a rather unfortunate commencement for a to-be-taken-seriously paragraph, we fear) that a company has offered "to connect all the large cities of the United States in such a manner, that when the President presses the button for the official opening of the Exhibition, he will not only start all the machinery, but ring the fire-bells, hoist the stars and stripes in every town in the country, and open the largest mechanical, electrical, and musical concert ever given on earth." Some big advertisement scheme appears to be at the back of this proposal, if it is really to be taken seriously, for no subsidy is asked and no conditions demanded, except a monopoly in the enterprise, such as it is.

NOTES.

National Telephone Company's Bill.—The Kent County Council will not oppose the National Telephone Company's Bill, on the ground that the opposition is already sufficient.

Canterbury Town Council and Electric Lighting.—Some dissension has arisen on the Canterbury Town Council on the electric lighting question, and in consequence the town clerk has tendered his resignation. It appears that the Council came to a decision to come to terms with the Brush Company, and in consequence the town clerk submitted the agreement to Mr. Dickens, Q.C., which the Mayor considered to be an irregular procedure, as the agreement was passed by the whole of the Council. Against this the town clerk said he only took the usual course, and sides having been taken, the supporters of the town clerk accused the Mayor of being financially interested in the Brush Company. This has been promptly denied, and efforts have been made to induce the town clerk to withdraw his resignation.

The Edison-Lalande Cell.—The following letter from Mr. Gladstone, the superintendent of the Edison Manufacturing Company, arrived too late to be placed in our correspondence columns :—"My attention has just been called to your issue of February 19th, in which you reprint extracts from a letter which recently appeared in the *Canadian Magazine*, under the signature of a Mr. W. B. Shaw, regarding the Edison-Lalande battery. Mr. Shaw states that our claim that there is no local action in cells when not in use is incorrect, as 'he has had zincs eat through and drop off when battery is left continually upon open circuit.' I have no idea of the status of this gentleman in electrical circles, having never heard of him to the best of my recollection, but it is very evident that he has entirely disregarded the very explicit 'directions for setting up cells' which we send out with every battery, or he would not have arrived at a conclusion, which is diametrically opposed to the general consensus of scientific opinion regarding the working of these cells. We expressly state, and emphasise the same by printing in italics, that 'it is most necessary that oxide plates should be entirely submerged in caustic potash solution, so that the top edges of oxide plates should be at least 1 inch below the layer of oil.' Mr. Shaw evidently filled cells, so that the top edges of oxide plates were either on a line with the top of the solution or above it, *otherwise it would have been impossible* for the zincs to have eaten off as he describes. It is manifestly unjust to condemn a battery for not acting properly when our instructions were completely ignored, as has undoubtedly occurred in the case in point. Allow me to state, further, that our cells have been repeatedly tested by several of the most prominent scientists in America, and that their conclusions fully sustained all we claim for these batteries. We are also perfectly willing to furnish any of the leading scientific institutions in England with sample cells for making local action tests, knowing that they will fully corroborate our widest claims. At the present time we have a number of cells in our laboratory at Orange, N.J., which were placed in operation on June 18th, 1890. The loss from chemical action throughout the entire period has been less than 1 per cent. per month on open circuit, which is practically nothing, and there has been no local action whatever during the whole time. In the office of the Edison United Phonograph Company, of Northumberland Avenue, one of our batteries has been running a phonograph for about ½ hour to 1 hour every day since August 1st, 1891, and it is still in working order. Our batteries are now extensively used in some of the largest offices of the Western Union Telegraph Company, several of the most important telephone companies, and a large number of the most prominent railways in the United States, among which I may mention the Pennsylvania Railroad, the Baltimore and Ohio Railroad, the New York, New Haven, and Hartford Railroad, among others, all of which use it on both open and closed circuit work. It is absurd to suppose that such progressive corporations would continue to use the Edison-Lalande battery if it had such grave defects as Mr. Shaw charges in his recent letter.

Comparative Cost of Gas and Electricity.—Referring to our articles regarding the costs of gas and electricity, in which we have stated that a flat flame burner, consuming 5 feet of gas per hour, produces 15 candle-power, we notice a paragraph appearing in our contemporary, the *Gas World*, which serves to further vindicate our statements upon the matter. The note runs as follows :—"For four weeks ending the 13th inst., Mr. Dibdin reports to the London County Council eight failures of the illuminating power of the gas supplied to the metropolis—three each against the South Metropolitan and Commercial Gas Companies and two against the Gas Light and Coke Company. The lowest return was 15·5 candles—against the South Metropolitan Company." So that our figures, *i.e.*, 15 C.P., are really lower than the minimum production per 5 feet of gas, as given by Mr. Dibdin.

The Lundy Island Cable Wanted.—The tugboat *Elliot* and *Jeffrey* arrived at Cardiff Docks on Monday last, and reported the steamer *Tunisie*, which left Cardiff on Thursday bound for Marseilles with a cargo of 1,800 tons of coal, to be on shore on Lundy Island. The crew had a narrow escape, owing to there being no life-saving apparatus on the island, and no telegraph communication with either side of the Channel. The crew were hauled up the cliff, 80 feet high, in canvas bags, and the inhabitants of the island and the men from the lighthouse worked for hours during a blinding snowstorm. The vessel is full of water, and will soon be a total wreck. Signals had been flying since Friday for assistance, but no vessel passed near enough to see them. It is much to be regretted that the old cable was not kept in order, but the case is to be brought before the Board of Trade, for the purpose of establishing fresh telegraphic communication between the island and the English or Welsh coasts.

Kingswood Electric Lighting.—We hear that one evening last week Kingswood was lighted for the first time by electricity, the district illumined being from Hanham Road to Warmley. The installation was generally considered satisfactory.

Mr. Tesla in a New Guise.—*Church Bells*, a weekly paper for Church folk, speaks of Mr. Nikola Tesla as Edison's right-hand man.

The Globe's Earth Currents.—It is well known that the terrestrial globe is traversed by earth currents, but it is not equally common knowledge that a daily pink-hued contemporary is mightily troubled with the same disturbing influences. Let the following lines speak for themselves :—These currents are nearly always present in the ground, and the wires connected to it; but as a rule they are feeble, and do not interrupt the working of the telegraphs. On submarine cables they have been known to attain a strength equal to that from a battery; and in America, during a former auroral period, an arc lamp was kept lighted for some time by connecting it to one of the telegraph lines.

The Microphone and its Uses.—Prof. Hughes having been engaged for many years experimenting with his microphone for the detection of sounds too feeble for the unaided human ear, will be pleased to notice, by the following paragraph in the *Daily Telegraph* of February 25th, that it has been successfully applied in St. Petersburg to the saving of human life :—"Some particulars of a remarkable case of revival from apparent death have come to hand from St. Petersburg. A lady who had been suffering from a violent nervous attack sank into a state of syncope, and after a time ceased, as it seemed, to breathe. The doctor who was attending her certified that death had resulted from paralysis of the heart. For some reason which is not explained another medical man, Dr. Loukhmanow, saw the body, and having been informed that the lady had suffered from attacks of hysteria and catalepsy, thought it worth while to make a thorough examination. After trying various other means he applied the microphone to the region of the heart, and was enabled by this instrument to hear a faint beating, which proved that life was not extinct. Everything was done to resuscitate the patient, who, shortly afterwards, recovered consciousness."

Personal.—Mr. William Porton has been appointed Director-General of State Telegraphs in Chili. He was for many years station manager at the Iquique branch of the West Coast of America Telegraph Company.

Mr. Ernest G. Pink no longer holds the post of chief engineer at Madrid for the Electricity Supply Company for Spain, and has returned to London.

Obituary.—Mr. Neil Bannatyne, director of the India-rubber, Gutta-percha and Telegraph Works Company, and of the Cuba Submarine Telegraph Company, died on the 15th inst., at his residence, 15, Earl's Court Square, S.W., and we also hear that Mr. Alfred Marshall, the chairman of the West Coast of America Telegraph Company, died a few days ago.

We regret to announce the death of Mr. George Worthington, the founder and editor of our New York contemporary, *Electrical Review*, which took place on February 3rd, at Buffalo, N.Y.

The death of Major-General Alexander, late of the Bombay service, took place on the 10th inst. For several years past Major-General Alexander had taken an interest in electrical matters, and he was a shareholder in several companies connected with electrical industry, and for the past three years acted as chairman of Shippey Brothers, Limited.

Electric Lighting at Cambridge.—The Cambridge Town Council last week adopted a committee report, which means the virtual abandonment of the idea of promoting the electric light by the corporation, but a clause was added that in any negotiations provision should be made for the powers being taken over by the corporation (if thought fit) after a given number of years.

Storage Batteries.—According to the New York *Electrical World*, it seems that the storage battery has been pronounced a failure by the president of the Dubuque Street Railway Company. He states that in May, 1891, their company started six cars, and by about the beginning of July the batteries had begun to give way. The Accumulator Company were at once notified of this, and for some weeks there were three of that company's electricians operating upon the plant. The results since then, says the president, however appear to have shown that it is utterly impossible to make the storage battery a success, as the second and third sets of positive plates gave out in a similar way as the first, and were not able to do nearly the same distance as was expected of them. The president also gives figures of the original cost and maintenance of batteries since their adoption by the Dubuque Street Railway Company; he further says that the Dubuque people consider the storage battery system an intolerable nuisance, and would prefer to have the horses and mules back again, so disgusted are they with its working during the last four or five months. He has been compelled at last to instal the overhead system on their road, although he would have much preferred the storage battery system if it could be made a financial success.

New Journal.—We have received a copy of the first number of a new French journal, which is published at Paris, under the title of *Sciences and Commerce*. Our new contemporary, we understand, will not treat with technical matters, but merely general news regarding the electrical, telephonic, and telegraphic trades.

Croydon County Council and the Electric Light.—The Croydon County Council is evidently in no hurry to put into operation the provisional order for supplying the electric light. Whilst itself delaying it, is against anyone else doing that for which the order was obtained, for it has just decided not to go on with the order, whilst an application from a private firm to purchase the rights from the council has been refused. Presumably provisional orders are granted on the understanding that they are wanted, and not to enable the promoters to play at the "dog in the manger." It must be remembered that the light is in demand for private as well as public purposes, and those who prefer it to gas should have as much facility for obtaining it as they have for obtaining gas.

Liverpool Electric Lighting.—We understand that the Corporation of Liverpool has been asked by the Liverpool Electric Supply Company to extend the period originally agreed on for their purchasing the electric lighting undertaking, from twenty-one years to forty-two years. The Watch Committee has decided to recommend the Council to consent to this, provided that the company agrees to power being inserted in the order for the Corporation to purchase the undertaking as a going concern at any time after December 31st, 1897, upon giving twelve months notice to the company to this effect.

The Telephone between Dublin and Belfast.—After many difficulties the National Telephone Company and the Telephone Company of Ireland have at length been able, telephonically, to join hands, and within a few weeks Belfast will be connected with the Irish metropolis by telephone.

Aberdeen and Electric Lighting.—The Gas Committee of the Town Council had under consideration, the other day, the question of electric lighting for the city. A sub-committee was appointed to collect information as to the steps taken by the corporations of other large towns.

Bermondsey Vestry and the Electric Light.—The General Purposes Committee reported at the recent meeting of this vestry that they had instructed the surveyor to communicate with the Electric Supply Company as to the cost of providing a current for arc or incandescent lamps for the parish; that they had instructed the surveyor to obtain from the company an estimate for lighting Southwark Park Road from the "John Bull" to the Upper Grange Road, and the whole of the Jamaica Road, with arc lights, the small power of refraction of incandescent lights precluding their use in main roads.

Postal Telegraphs at Stamboul.—A special commission has been appointed to audit the accounts of Lebib Effendi, director of the Post and Telegraph Office of Stamboul, who, as was lately reported, has been suspended.

The Electric Light in Hungary.—Four tenders have been sent in for the proposed central station for the electric lighting of the town of Arad in Hungary, and the committee is at present engaged in the work of deciding as to which firm shall receive the contract. The tenders received were from Messrs. Ganz & Co., Budapest, Messrs. Egger & Co., Budapest, the Berlin Accumulator Company, and a Stuttgart firm.

The Electric Light in France.—The offices of the French Minister of Marine at Paris are being fitted with the electric light.

Manchester Corporation Electric Light.—We understand that Messrs. Galloways, Limited, Manchester, have received the order for the six boilers and four large engines for the Manchester Corporation electric light installation. All have to be at work by the end of July.

Blackpool Electric Lighting.—The Corporation of Blackpool propose to have a more extended scheme of electric lighting. The lights along the promenade will be carried as far as the "Glynn Inn" on the north shore, and to the extreme end of south shore. It is also proposed to have the electric light in several of the leading streets in the town, and likewise to supply places of business and shops requiring it.

The Proposed Extension of the Electric Railway to Islington.—The Parliamentary estimates of the cost of extending the City and South London Railway to Islington have been prepared by Mr. J. H. Greathead, the engineer to the Company. The length of this extension is given in these estimates as 2 miles 5 furlongs 3 chains, and the total cost is set down at £706,633. Of this sum, £330,540 will, it is estimated, be spent in tunnelling, £211,000 upon the acquisition of land and buildings, £81,600 upon stations, and £13,500 for the subway for foot-passengers to and from Fish Street Hill. The laying of the permanent way will absorb £15,844, of which £2,500 will be for sidings, whilst for contingencies a sum amounting to £54,149 is allowed.

The Electro-Harmonic Society.—The concert of next Friday is a Ladies' Night, and Mrs. Alexander Siemens has again graciously consented to take upon herself a large share in the programme; her appearance alone should suffice to bring together a crowded house. Mr. Ed. C. de Segundo and Mr. T. H. Harrison are also announced to sing, and the former gentleman will, in addition, give a solo on the piano, as will Mr. H. M. Higgs on the Mustel organ. Mr. Izard and Mr. Gatehouse will play Beethoven's "Kreutzer" sonata, and a small but efficient orchestra will perform several selections, including the famous "Intermezzo," from Mascagni's opera, "Cavalleria Rusticana." Altogether, a pleasant evening may be anticipated.

The Royal Society.—The following paper was down for reading last night:—Prof. Ewart. "Observations on the Structure, Relations, Progressive Development and Growth of the Electric Organ of the Skate."

Society of Arts.—Prof. William Robinson, of Nottingham, is about to deliver a course of four Cantor lectures on the "Uses of Petroleum in Prime Movers," before the Society of Arts, on successive Monday evenings, the first lecture being on Monday next, 29th inst. After dealing with the subject generally, the lecturer will treat of petroleum oil engines, oil gas, and gaseous fuel for steam boilers.

Electrically Controlled Organs.—We have received a letter from Mr. Conti, in reply to Mr. Hope-Jones, but too late for insertion in this week's issue of the REVIEW.

Amalgamation of Electric Companies.—We understand that the Edison and Thomson-Houston Companies are uniting their businesses. The details of the consolidation have not yet been fully completed.

Hyper-criticism.—*Lightning* finds fault with the heading of one of the columns in our recent table of particulars of central electric lighting stations of the United Kingdom, when we wished to know the coal consumption per hour for a unit delivered at the dynamo terminals. The ELECTRICAL REVIEW does not require any assistance from the *Lightning* glossary to define a unit, but evidently our contemporary would have us write "coal consumption *per hour* per 1,000 watt *hours* delivered, &c." Surely everybody but the gentleman "on the look out" could see that our question was quite in order.

NEW COMPANY REGISTERED.

Electro-Automatic Fire Extinguishing Company, Limited.—Capital, £12,500, in £1 shares (6,940 ordinary, 5,500 preference and 60 founders'). Objects; to carry into effect an agreement to be made between C. M. Martin, of 8, Imperial Buildings, Holborn Viaduct, E.C., of the one part and the company of the other part, for the sale to the company of certain inventions and letters patent; and to carry on business as manufacturers, vendors, and lessors of fire checks or fire extinguishing apparatus. Signatories (with one share each): C. Sudbury Cavendish, House Park, Nottingham; E. B. Sudbury, 348, Broadway, New York; J. Frecstone, West Bridgeford, Nottingham; F. Sudbury, Field House, Ilkeston; G. Glass, 7, Mount Edgecumbe Gardens, Clapham Rise, S.W.; W. R. Dover, 86, Moray Road, Tollington Park, N.; H. H. Flack, 10, Lamart Road, Chelsea, S.W. Registered without articles of association on the 16th inst. by Fox & Joy, 59 and 60, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Mutual Telephone Company, Limited.—The annual return of this company, made up to the 14th ult., was filed on the 19th inst. The nominal capital is £350,000 in £10 shares, 4,135 of which have been taken up, a call of £8 per share made and £31,750 paid, leaving £1,330 unpaid. Registered office, 10, Tokenhouse Yard, E.C.

St. James's and Pall Mall Electric Light Company, Limited.—The annual return of this company, made up to the 9th inst., was filed on the 18th inst. The nominal capital is £200,000 divided into 20,000 preference and 19,980 ordinary shares of £5 each, and 100 founder's shares of £1 each. All the founders' and preference, and 18,680 of the ordinary shares have been taken up, the full amounts called on each, and all calls paid, amounting to £193,500. Registered office, Mason's Yard, Duke Street, St. James's, S.W.

Maquay Syndicate, Limited (Patentees of Voltaic Batteries).—The annual return of this company, made up to December 25th, 1891, was filed on December 30th. The nominal capital is £12,000 in £100 shares, 92 of which have been taken up, 60 issued as fully paid, and the full amount called upon 29. The calls paid amount to £2,550, leaving £350 unpaid. (It will be noticed that no information is given respecting the remaining 3 shares.) Registered office, 9, Frith Street, Soho Square, W.

Morecambe Electric Light and Power Company, Limited.—The statutory return of this company, made up to November 30th, 1891, was filed on December 9th, 1881. The nominal capital is £15,000, divided into 50 founders and 14,950 ordinary shares of £1 each. 32 founders and 2,136 ordinary shares have been taken up, of which 360 ordinary shares have been issued as fully paid. Upon the founders shares the full amount has been called, and upon the remaining ordinary shares 4s. per share has been called. £339 15s. has been paid, leaving £47 9s. unpaid. Registered office, 18, The Crescent, Morcambe, Lancashire.

J. E. H. Gordon and Company, Limited.—The annual return of this company, made up to the 8th inst., was filed on the 16th inst. The nominal capital is £50,000 in £10 shares. All the shares have been taken up, of which 3,000 have been issued as fully paid. Upon the remainder the full amount has been called, and with the exception of £30, paid.

A notice that the capital had been increased to £100,000 by the creation of 5,000 new shares of £10 each, was also filed on the 16th inst. Registered office, 11, Pall Mall, S.W.

Mining and General Electric Lamp Company, Limited.—The annual return of this company, made up to the 27th ult., was filed on the 2nd inst. The nominal capital is £100,000 in £1 shares, 91,500 of these have been taken up, of which 62,305 have been issued as fully paid. Upon the remaining 29,125 the full amounts have been called and paid. Registered office, 11, Abchurch Lane, E.C.

London and Western Syndicate, Limited (contractors for the erection, equipment and management of electric light, heat and power supply works, telephone and telegraph works, &c.)—The following was filed on the 8th December, 1891: "To the Registrar of Joint Stock Companies.—I beg to inform you that a meeting of the above named company was held on December 7th, 1891, in order to have an account laid before the company, showing the manner in which the winding-up had been conducted, and the property of the company disposed of, and that such account was laid before the said company, and was received and adopted. Dated this 8th day of December, 1891; (signed), Charles F. Richardson, liquidator." Registered office, 16, St. Helen's Place, E.C.

MacMahon's Patent Electric Check System, Limited.—The statutory return of this company, made up to July 18th, 1890, was filed on the 15th inst. The nominal capital is £30,000 in £10 shares. All the shares had been taken up, and 2,000 issued as fully paid, while upon the remaining 1,000 £2 10s. per share had been called and paid.

The first annual return, made up to the 14th ult., was also filed on the 15th inst. Upon 1,000 shares of £5 7s. 6d. per share had been called, resulting in the payment of £4,943 15s., and leaving £431 5s. in arrears. Registered office, 24, Great Windmill Street, Piccadilly, W.

Eastern Telegraph Company, Limited.—The annual return of this company, made up to the 28th ult., was filed on the 18th inst. The nominal capital is £4,700,000, divided into 70,000 preference and 400,000 ordinary shares of £10 each; 469,998 shares have been taken up, the full amount called, and all calls paid. Registered office, Winchester House, Old Broad Street, E.C.

BUSINESS NOTICES, &c.

Woodhouse and Rawson United.—The following is a *resumé* of the work which has been carried out by the Johannesburg branch of this company during the past year:—(1) The carrying out of the first contract for the lighting of this town, consisting of a number of arc lamps, which have now been running during the last six weeks. (2) The preparation of plans and specifications for the electric lighting of Pretoria, and the supervision of the erection of buildings, &c., by the contractors. (3) The supply and erection of plant for lighting the works, both above and below ground, of the City and Suburban Gold Mining Company, Limited. (4) The supply and erection of plant for lighting the works, both above and below ground, of the Metropolitan Gold Mining Company, Limited. (5) The lighting of the Battery House of the Van Ryn Gold Mining Company, Limited. (6) The lighting of the Globe Theatre. (7) The preparation of the plans and specifications for transmission of power by means of electricity, for Moodies Gold Mining and Exploration Company, Limited. Besides the above, a large number of telephones, lightning conductors, electric bells, &c., &c., have been erected, as well as the sale of a very large quantity of electrical goods and accessories of all descriptions. In addition to the branch here, which is the head office of the firm for the whole of South Africa, the firm have sub-agents and store goods in the following towns:—Cape Town, Kimberley, Parberton, Pretoria, Maritzburg and Durban.

Laxton's Builders' Price Book.—Messrs. Kelly & Co. have just published the new edition for 1892 of this useful annual. While the electrical information, which is well up to date, should be useful to those engaged in the building trade, a good deal of the general contents of the book would be found valuable, for reference, by the electrical engineer. This edition contains the whole of the Metropolitan Buildings Act with Notes of Cases, explanatory of its law and practice; decisions thereon in the Superior Courts of Law; the unrepealed sections of the previous Building Act; the Bye-Laws of the London County Council; as well as the regulations of the Council relating to theatres and other places of amusement, and a list of District Surveyors.

Catalogues.—We have received from the General Electric Company, Limited, a copy of the Ninth Edition of their Electric Bell and General Catalogues. This book contains illustrations, and prices and particulars of the various telegraph supplies, fire alarms, batteries, lightning conductors, and other fittings and instruments manufactured by the company. We have pleasure in recommending to the electrical trade generally This firm are also shortly publishing some other catalogues of electric light plant, supplies and machinery, telephones, telegraph supplies, and medical electric appliances.

Fire at Hodges & Todd.—Referring to the disastrous fire which occurred yesterday week in Verulam Street, we understand that this fire did not originate on this firm's premises as reported by many of the daily papers, but commenced on the adjoining premises and ultimately destroyed Messrs. Hodges & Todd's works. The firm have, however, taken new premises at 19, Kirby Street, Hatton Garden, and the work of fitting up is being rapidly pushed forward.

Private Installation.—From the *City Press* we understand that Messrs. D. C. Apperly, Carson & Co., woollen warehousemen, of 5, Cripplegate Buildings and 13, Fore Street, have decided, after inspecting various installations and systems of electric lighting, that it will be to their advantage to have their own plant. They are now having a complete plant installed by the Wenham Company.

The Electric Light in the West End.—The Planet Electrical Engineering Company are fitting up an installation of the electric light at Gilbert's Hotel, 47, Chandos Street, W.C. Messrs. Verity and Sons, of King Street, Covent Garden, are also fitting up an installation in the large buildings, 90, Charing Cross Road, W.C.

T. Fleming, Son & Co.—This old established firm, well known as makers of leather machine belting, are amalgamating with six other Yorkshire firms under the title of Fleming, Birkby and Goodall, Limited.

A. P. Lundberg.—We have received a copy of Mr. A. P. Lundberg's new price list, which contains descriptions of his latest novelties and specialities in electric lighting fittings.

CITY NOTES.

The Westminster Electric Supply Corporation, Limited.

THE annual ordinary general meeting of the above corporation was held on Wednesday last at Westminster Palace Hotel.

The SECRETARY having read the notice convening the meeting,

Lord SUFFIELD, K.C.B., who was presiding, stated that he regretted he was not yet sufficiently recovered from his illness to address them as he would have liked to have done. He would, however, formally move the adoption of the report and accounts (which were published in our columns last week), and his friend, Mr. James Heslop Powell, would do his duty for him on this occasion, so far as explanations were concerned.

Mr. POWELL then stated that he presumed they would take the report and accounts as read. The board had the pleasure of congratulating the proprietors upon the position of the three central stations. One in Millbank Street, which was practically complete, in fact he did not think that any more payments would have to be made with regard to it except for some condensing apparatus. Then they had the Central Station at Eccleston Place, which, so far as the plant and works were concerned, was almost complete, and then they had further the station at Davies Street which was almost in a similar state. At Eccleston Place they were making provision for offices of the company, for the secretary's office, for offices for the engineer and his assistants, and a board room, and the erection of those buildings would be completed for an amount, the interest of which would be very considerably less than the rental they had been paying for some inconvenient premises in Victoria Street. At Davies Street they were covering the frontage with flats or chambers erected at no very large cost, and they expected a very considerable rental from them. The buildings had all been put up in the most substantial way, and he hoped any shareholders who had the opportunity would go and see for themselves how they had combined the very best construction without being at all extravagant. He thought they would all say if they saw those buildings that they were a model to the neighbourhood in which they were situated. He believed that they would all be surrounded by buildings of a similar kind. The greatest care had been taken by their engineer to put up machinery which was of the best description at the lowest possible cost, and, moreover, he believed, most economical. But they had arrived at that result after a great many drawbacks; in the first place, their architect had told him that they were delayed at least 66 days by the severe frost of 1891, and the carpenters' strike at least six months; yet, notwithstanding those great drawbacks, the promises which were held out to them at the last general meeting, that they would be able to work Eccleston Place within about a fortnight, were fulfilled in less than that time. Within a week of the meeting, *i.e.*, by March 2nd, they were able to start Eccleston Place, and on March 4th they were able to supply light to Her Majesty's Drawing Room with as much perfection as he believed characterised any of their lighting. Then he must tell them that in February of last year they had only 13,140 lamps on circuit, and to show how the electric current was wanted, they found that in March there was an increase of 5,842 lamps; in April, 9,992; in May, 6,789; that is, in round numbers, about 22,000 lamps increase over and above the very small number that they were supplying at the end of February, which was only 13,140. Then by the end of June they were supplying about 37,000 lamps, that was in round numbers about three times what they had been supplying in February. But when June came sunlight was beginning to take the place of electricity; people were beginning to think of leaving their town residences, and notwithstanding the great increase of their lamps, they found that their revenue did not increase in like proportion, but the increase of lamps still went on. In June they had an increase of 1,500; in July, 2,700 odd; in August, 2,500 odd; and as the days got shorter the increase became larger still; it became 4,900, and he thought it was very gratifying under the circumstances. Still, they had no increase of revenue. The light of the sun kept business away, and it was not until October that they began to realise the great increase that they had made in their business, and it was not until December that they found that fog was always their best friend, and he believed it always would be. In December their receipts rose in one week from £800 to £1,200; that is, an increase of 50 per cent. That put a very heavy strain upon their engineer and all who worked under him, and he was happy to say that the supply in that week was as good as it had ever been, and it was the more gratifying for him to say that when in the following week the receipts for light fell down again from 1,200 to its normal state of £800, the expenses also seemed to decrease almost automatically. The figures which he had given them would well explain why the income they showed on December 31st was so small, because during the first part of the year they had comparatively few lights; it was only as the season went on that the great increase took place; and again, it was only in November and December that they saw what a valuable business they had. It would be interesting for them to know what was likely to be their income from the present circuit of lamps. He took their present circuit at the very low figure of 68,000. He might say that since December 31st the number of lamps lighted had so largely increased, that they had arrived at the present moment at the figure of 75,253, but he would take the very moderate figure of 68,000, and take the still more moderate estimate of 10s. per lamp, and that would show them that they should have an annual income of £34,000, instead of the comparatively small income thus shown in the published accounts. Those accounts showed that their income was £19,000, so that upon a lamp circuit of 68,000 they would have an increase of revenue of £15,000, but of course those figures were very far within the mark. They found now that their increase of applications per month amounted to something like 4,000 lamps, and they saw no reason why that figure should be less, although they could hardly expect that this year they would gain the enormous increases which were shown during the last year. He was quite satisfied that if they supplied a good light at a moderate price, the people would see that electric lighting was become one of the necessities of the age, that it was necessary for people's comfort in their houses, and it was also most necessary to the conduct of business. In his own very small experience he occasionally went to an hotel, and he always chose the hotels which had the electric light. He found it was the best light, and gave the least unpleasant heat, and there were no unpleasant fumes from it. He looked upon it that every hotel and club house would in a short time be obliged to avail themselves of the electric light offered to them. He must again recall to their minds the very great disadvantages under which they had been during the past year. Anyone who had gone to Davies Street station about that time last year would have said that it was truly impossible to supply the electric light from that station for several months. Everything was in the greatest confusion. They had an enormous number of excavators and builders and labourers at work, and the gentlemen present would know, from their own experience at their private houses, what a dust those workmen made, and how it was

destructive to machinery. Yet they saw a very large business that was offered to them, and thought it wise to put up a temporary building, and work that business at any reasonable cost. The cost was great, but he thought the advantages at the bottom of the cost of producing the light would well repay them. Having so far spoken upon what had taken place, and what were their probable requirements, it might naturally occur to many of them to ask him what provision they had made for the future. He thought he could tell them tolerably accurately. They found now that they were supplying about 65,000 lamps now on their present premises with their existing machinery, that is, either placed or on order; that they had accommodation at Millbank Street for 30,000 more lamps, at Eccleston Place 60,000 more lamps, and Davies Street for 75,000 more lamps, so that altogether, in addition to their present 130,000 lamps, they had accommodation on their premises, and machinery already fitted for their requirements, for 165,000 more, thus bringing their opportunity of supply up to 295,000, which, in round numbers, was about double their present output; but that was not the measure of what they could do. They found at Eccleston Place they had a very considerable space in addition, so that when the time came they would be able to enlarge their buildings to such extent; also at Millbank they would be able to enlarge their buildings to some extent, and that altogether, with their extra space, they would be able to supply about double the figure that he had mentioned, that was to say, that they now had 130,000 lamps; that they had accommodation on their existing premises for 165,000 lamps, and they believed that they had space accommodation to double that quantity, so that they had room for four times what they had at present. He thought that was great satisfaction. It was possible that they might have to put up a little more machinery to accommodate the extra number of lamps. He would not go on with those observations, but would refer to something more immediately pressing, and that was the amount they would have to allow for depreciation of machinery. In that account they had allowed £1,000, which they considered to be fair. Their machinery was new, and a great deal of it was not thoroughly worked until towards the end of the year, and although everything wore as soon as it was put into work, they thought that it was only right that they should put a certain sum against the depreciation of machinery, but he most not deceive them by letting them suppose that £1,000 would in any way be sufficient for the depreciation which they were likely to set against their revenue, and upon that matter he would quote the report of their engineer, which, he believed, they might thoroughly rely upon. In his report Prof. Kennedy stated that he thought it would be wise not to allow less than £100 per week to be set apart for depreciation, &c., as well as to prepare for any new inventions which might be brought out. Electric lighting being a young science, there would sure to be inventors getting up improvements of all kinds, which might probably make some of their machinery obsolete, a contingency which could not be otherwise provided for. Those figures, the chairman continued, of £100 a week had not been adopted by the board, but he might say that they had such very great confidence in Prof. Kennedy's figures, that he did not doubt but that they would see the wisdom of adopting those figures, and the policy which was recommended by him. He did not think he would be doing his duty if he were to claim for himself and his colleagues the credit of the results he had put before them, because they were very largely due to their superintending engineer, Prof. Kennedy. He had always kept his work well within his estimates. He could say that no company had carried out similar works at a less cost or with greater success than they had. He believed that no company within two years after its active existence had been able to supply the public with so many lights so well, and for that result they were in a great measure indebted to Prof. Kennedy. He had also to single out the architect for his pains. He had evidently entered into the spirit which had throughout engaged the board; and he had worked well and cordially with Prof. Kennedy. Captain Bax had been most successful in getting and dealing with customers. A shareholder had written to the secretary asking him to answer a question at the meeting, as to how it was that their cost of generating electricity appeared to be so high in comparison with the cost of another company. The reason was that that very company began with a good business at the beginning of 1891; also during the whole of the year their own company had to have an engineering staff to do a small business, and it was not until September or October that they actually paid their working expenses, therefore the cost of generating electricity appeared to be comparatively high, but if they went into the details of it, he thought they would find that their cost was quite as low as the other company, and that the explanation he had given was ample for the purpose.

MR. WM. COOPER asked for certain information regarding the issue of debentures, and Mr. FITCH also asked regarding the cost of coals and waste water.

The CHAIRMAN answered Mr. Cooper satisfactorily, and Prof. KENNEDY gave Mr. Fitch the information he desired, and the motion was then put to the meeting and carried unanimously.

The re-election of Messrs. Cooper Bros. & Co., at a remuneration of £52 10s., as before, was the next business, and a vote of thanks to the chairman and directors terminated the proceedings.

India-Rubber, Gutta-Percha, and Telegraph Works Company.

THE 28th ordinary general meeting of the India-rubber, Gutta-Percha, and Telegraph Works Company, Limited, was held on Tuesday last at Cannon Street Hotel, under the presidency of Mr. S. Wm. Silver, chairman of the company.

The SECRETARY (Mr. W. J. Tyler) having read the notice convening the meeting,

The CHAIRMAN, in moving the adoption of the report and accounts (which appeared in our columns last week), and the declaration of a dividend of 10s. a share, with a bonus of 5s. a share, free of income-tax, which with the interim dividend paid in July would amount in all to 12½ per cent. for the past year, said that, after adding £25,000 to the reserve fund—raising that fund to £325,000—there remained £42,073 to be carried forward. He wished to impress upon them the fact that the amount of their share capital was very small, when they considered the nature and extent of their business. By looking at the accounts they would see that the first item of assets and expenditure was £70,000 more than the whole of their share capital. Some shareholders did not see the advantage of their reserve fund, but it was necessary; in fact, the working capital, with the reserve fund added, was too small to enable them to undertake expensive contracts when offered. Taking this into consideration, the board thought that the time had come for increasing still further their capital, and their present intention was to issue some new shares. Of course they would be issued at a premium, and it was proposed to offer them to the shareholders in proportion to their holding, so as to give each one the opportunity of increasing his stake in the company. As to the future he could only say that their prospects were very encouraging. It was his painful duty to inform them of the death only last week of their old and esteemed colleague, Mr. Neil Bannatyne.

Mr. ABRAHAM SCOTT seconded the motion.

Questions were asked by Messrs. COCKERILL and SWEET, and the CHAIRMAN having satisfactorily replied thereto, the motion was put to the meeting and carried unanimously.

The CHAIRMAN then proposed the re-election of two of his colleagues, Mr. Abraham Scott and Mr. A. Weston Jarvis, M.P., as directors of the company. This was seconded by the Hon. HENRY MARSHAM, and carried.

Mr. Weise was then re-elected auditor to the company, and a vote of thanks to the chairman, Mr. Matthew Gray (managing director), and the other members of the board, terminated the proceedings.

The Exploration Company.

THE profits for the year ending December 31st last amounted to £2,115 19s. 10d. This the directors propose to carry forward, together with the balance brought from the last account of £1,762 16s. 7d., making a total of £3,878 16s. 7d. The past year has not been favourable to the completion of several important transactions in which the company is still interested, but the company has been instrumental in successfully bringing out the City of London Electric Lighting Company, Limited. The shareholders have been informed by a circular of the prominent part taken by the company in an undertaking of great importance—the Central London Railway. The Royal assent to the Act of Parliament authorising it was obtained on August 5th, 1891. Notice has been given for this Session of a Bill for an extension to Liverpool Street of the line already sanctioned.

Telegraph Construction and Maintenance.

THE report of the directors for the year 1891 states that the accounts for the year show a net profit of £85,199, after charging the interest on the debentures. To this sum must be added £61,524 brought forward from last year, making a total of £146,724. From this amount is deducted the interim dividend of 5 per cent., paid July 14th, 1891, amounting to £22,410, leaving £124,314 to be dealt with. Of this sum the directors propose to distribute a dividend of £1 16s. per share, absorbing £67,230, being at the rate of 15 per cent., and making, with the amount already paid, a total dividend for the year of £2 8s. per share, or 20 per cent., free of income-tax, leaving £57,084 to be carried forward to the next account.

Stock Exchange Settlements.—The Stock Exchange Committee have appointed special settling days in the following securities: Thursday, February 25th, Halifax and Bermudas Cable Company, Limited, £120,000 4½ per cent. first mortgage debentures. Friday, February 26th, West India and Panama Telegraph Company, Limited, £80,000 5 per cent. debentures (1917); and have ordered the undermentioned securities to be quoted in the official list: Brush Electrical Engineering Company, Limited, 5,004 additional preference shares, Nos. 69,997 to 75,000; St. James's and Pall Mall Electric Light Company, Limited, 10,000 additional 7 per cent. preference shares, Nos. 30,081 to 40,080; West India and Panama Telegraph Company, Limited, £80,000 5 per cent. debentures (1917).

The Direct Spanish Telegraph Company Limited.—The board decided, upon the accounts for the half-year ended December 31st, 1891, being submitted to them on Wednesday, subject to audit, to recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend at the rate of 4 per cent. (free of income tax) on the ordinary shares, making with the previous half-year's dividend a total distribution of 4½ per cent. for the year on the ordinary shares.

The Portsmouth and South Hants Electricity Supply Company, Limited.—A general meeting of members of this company will be held at 46, St. James's Street, Portsea, on March 21st, 1892, for the purpose of having an account laid before them, showing the manner in which the winding up of the said company has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Feb. 18th.)	Closing Quotation. (Feb. 25th.	Business done during week ending (Feb. 25th, 1892.) Highest.	Lowest.
250,000£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 — 102	99 —102	...	...
1,300,980£	Anglo-American Telegraph, Limited	Stock	49 — 50 xd	49 — 50	49½	49¼
2,849,510£	Do. do. 6 p. c. Preferred	Stock	88 — 89 xd	88 — 89	89	88½
2,849,510£	Do. do. Deferred	Stock	12 — 12⅛	11⅜— 12⅛	12 1/16	...
130,000	Brazilian Submarine Telegraph, Limited	10	10⅞— 11¼	10⅞— 11¼	11⅛	10 13/16
53,200£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3¼— 3½	3⅛— 3⅜	3⅜	...
69,996	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2 — 2¼	2 — 2¼	2¼	2⅛
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2⅞— 3⅛	2⅞— 3⅛	...	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152, £4 paid	10	6¼— 6½	6¼— 6⅜	6¼	...
$7,716,000	Commercial Cable, Capital Stock	$100	153 —157	153 —157	155½	155
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	⅜— ½	⅜— ½	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½ — 6	5½— 6	5 15/16	5¾
16,000	Cuba Telegraph, Limited	10	10 — 11 xd	10 — 11	10 1/16	...
6,000	Do. do. 10 p. c. Preference	10	16 — 17 xd	16 — 17	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3¼— 3⅜	...	...
6,000	Do. do. 10 p. c. Preference	5	8½— 9½	8½— 9½	9 1/16	...
60,710	Direct United States Cable, Limited, 1877	20	11 — 11¼	11 — 11¼	11 1/16	11⅛
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅛— 14⅜	14⅝— 14⅞	14⅝	14⅛
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15½	14 15/16
200,000£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	105 —108	105 —108	106	...
1,200,000£	Do. 4 p. c. Mortgage Debenture Stock	Stock	107 — 110	107 —110	10 9/16	108⅛
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15 — 15¼	14 7/16— 15⅛	15⅛	14⅜
78,300£	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
276,200£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	105 —108	106 —109	108⅜	106½
135,000£	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	102¼	...
180,400£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	103½	101
201,600£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	5⅜— 6¼	5¼— 5⅜	5⅞	5⅝
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅜— 2⅝	2⅜— 2⅝	2⅝	2 7/16
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3⅛— 3⅜	3 — 3¼	3¼	3
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd,	2	1¾— 2	1¾— 2	1⅞	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅞— 10⅛	9⅞— 10⅛	10 1/16	9⅞
180,042	Do. do. 6 p. c. Preference	10	14⅝— 15⅛	14⅝— 15⅛	15 1/16	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19½	18⅞— 19½	18⅞	...
220,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	106 —109	106 —109	108	107
12,134?	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	7¾— 8¼	7¾— 8¼	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9¼— 10⅛	9¼— 10⅛	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½— 22	21 — 22	22¼	21⅛
200,000£	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	104½	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	3½— 4½	3⅛— 4½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8 — 9	8 — 9	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	2⅜— 2⅞	2⅜— 2⅞	2⅝	2⅜
10,000	Do. do. fully paid	5	4⅜— 5	4¼— 5	4⅝	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	8½— 9	8¼— 8⅝	8⅜	8 5/16
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅛— 4⅜	4⅛— 4⅜	4¼	4⅛
15,000	Do. 6 p. c. Cum., 1st Preference	10	13⅛— 13⅜	13 — 13⅛	13⅜	13⅛
15,000	Do. 6. p. c. Cum. 2nd Preference	10	11½— 12½	11½— 12½	...	...
420,000£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	104 —107	104 —107	105⅜	105½
250,000£	Do. (issued at 5 p.m., all paid)	...	54 — 57	54 — 57	...	...
6,318	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	5 — 6	4⅛— 5⅛	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	¼— ⅜	¼— ⅜	...	...
9,000	Reuter's Limited	8	7⅞— 8	7⅞— 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¼— 8⅜	8¼— 8⅜	8¼	...
7,900	Do. do. do. 7 per cent. pref.	5	7¼— 7⅜	7¼— 7⅜	7⅜	...
3,381	Submarine Cables Trust	Cert.	115 —120	115 —120	117½	...
78,949	Swan United Electric Light, Limited ... ... (£3¼ only paid)	5	3⅜— 4¼	4 — 4½	4¼	4
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	45 — 47	46½	45½
150,000£	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	103½	103
58,000	United River Plate Telephone, Limited	5	1 — 2	1 — 2	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	80 — 90	80 — 90	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7 — 8	7 — 8	...	...
271,400£	Do. do. 5 p. c. Debentures	100	101 —104	101 —104	103	...
30,000	West Coast of America Telegraph, Limited	10	4 — 5	4 — 5	4⅞	4⅝
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	101 —105	102 — 106	104⅛	...
67,007	Western and Brazilian Telegraph, Limited	15	10½— 10⅝	10½— 10⅝	10½	10 1/16
30,364	Do. do. do. 5 p. c. Cum. Preferred	7½	6¼— 6⅜	6¼— 6⅜	6¼	...
30,364	Do. do. do. 5 p. c. Deferred	7½	4 — 4½	4 — 4½	4 5/16	4 3/16
189,700£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	101 —104	101 —104	...	...
237,200£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	101 —104	101 —104	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅝— 1⅞	1⅝— 1⅞	1¾	1 11/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9½— 10	9⅜— 10⅛	10	9⅝
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8½— 9½	8½— 9½	...	...
£0,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	... — ...	99 — 103	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100£	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5⅜— 6¼	5¾— 6¼	6¼	5⅞

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid, 7½—7⅝.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Halifax and Bermuda Cable, 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 4¼—5.—7 per cent. Preference Shares of £5 (fully paid) 5¼—5⅜.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅜—6, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5½—6.—Liverpool Electric Supply Shares of £5 (fully paid), 4¾—5.—Do. shares of £5 (£3 paid), 2⅝—2⅞.—London Electric Supply Corporation, Ordinary (£5 paid), ⅞—1⅛.—Do. 6 per cent. Preference, 1½—1⅝.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅜—⅝.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—⅛.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—⅛.—Do. Debentures, 103—⅜.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅞—1⅛.—£5 Preference (fully paid) 2½—2⅝.—Ward's Electric Car (£10 paid), 1⅜—1⅝.

† Quotations on Liverpool Stock Exchange.

BANK RATE OF DISCOUNT.—3 per cent. (January 21st, 1892).

ELECTRIC RAILWAY, TRAMWAY, ELECTRIC LIGHTING BILLS, AND PROVISIONAL ORDERS.

THE Board of Trade have issued a report of the bills which will be brought before Parliament this session. Amongst others are the following:

ELECTRIC RAILWAY BILLS.

NAME OF BILL.	OBJECT OF BILL.	Capital Proposed. By Shares	Capital Proposed. By Loans.	Length of New Line Proposed.
		£	£	M. CHS.
Baker Street and Waterloo Railway.	To incorporate a Company for the making of underground railways from Baker Street Station to Waterloo Station, in two tunnels, by way of Langham Place, Regent Street, and Westminster; traffic to be worked by electricity or cable power; with power to enter into agreements with the Metropolitan, District, South Eastern, and Central London Companies.	1,250,000	416,000	3 1
Central London Railway.	To confer further powers upon the Central London Railway Company, to make a further railway from the Mansion House to Liverpool Street Station, and to abandon portion of their authorised line.	150,000	50,000	0 52
City and South London Railway (Islington Extension).	To empower the Company to make an underground railway (in two tunnels) to Islington, commencing in and under the High Street, Borough, and terminating in the City Road, Islington, with subways for foot passengers; traffic to be worked by electricity or other means than steam.	810,000	270,000	2 53
Great Northern and City Railway.	To incorporate a Company with power to construct a railway from the Canonbury Branch of the Great Northern Railway near Finsbury Park, and terminating at Finsbury Pavement, the greater portion to be constructed in two tunnels, and traffic to be worked by electricity or other motive power (not being steam locomotives).	1,500,000	500,000	3 38
Hampstead, St. Pancras, and Charing Cross Railway.	To incorporate a Company for making a railway (to be constructed in two tunnels, and approached by stairs or lifts), commencing in the parish of St. Martin-in-the-Fields, at Southampton Street, Strand, and terminating at High Street, Hampstead, a line from Seaton Street, Hampstead Road, to a point near King's Cross Station, and a subway in connection from Agar Street to the Charing Cross Station (the traffic to be worked by electricity or other motive power not being steam).	1,500,000	500,000	5 32
Liverpool Overhead Railway.	To extend the time for the construction of certain authorised railways; to empower company to make short extension railways; to raise additional capital; and for other purposes.	150,000	50,000	1 29
Waterloo and City Railway.	To incorporate a company for making an underground railway from near Waterloo Station to Mansion House, City, commencing in the parish of St. Mary, Lambeth, on the southern side of St. James's Street, and terminating in the parish of St. Mary Woolchurch, in the City of London, in Mansion House Street, line to be worked by electricity or cable; power to pay interest out of capital during construction.	540,000	180,000	1 46

TRAMWAYS PROVISIONAL ORDERS.

NAME OF ORDER.	OBJECT OF ORDER.	Length of the Proposed Tramways. Double Line.	Length of the Proposed Tramways. Sing'e Line.	Estimated Cost of Proposed Tramways.
		M. CHS.	M. CHS.	£
Bedford and Kempston	To authorise the construction of a Tramway in the borough of Bedford and in the parish of Kempston, on a gauge of 4 feet 8½ inches, to be worked by animal power, or, with the consent of the Board of Trade, by steam, electrical, or any mechanical power.	0 46	1 78	12,473
Blackpool, St. Anne's and Lytham.	To authorise the construction of a Tramway in Layton-with-Warbreck, Bispham-with-Norbreck, Marton Bispham, Poulton-in-the-Fylde, Lytham, and St. Anne's-on-the-Sea, on a gauge of 3 feet 6 inches, to be worked by animal power, or by steam, electric, or any mechanical power, including the cable system.	2 10	10 7	52,047
Hull Street	To authorise the construction of Tramways in Hull, in substitution of certain existing Tramways, on a gauge of 4 feet 8½ inches, to be worked by animal power, or by steam, cable, electrical, or other mechanical power; to confirm an agreement between the Official Liquidator of the Hull Street Tramways Company and the Promoters for the sale of the existing Tramways; to sanction the purchase by the Corporation of Hull of the existing Tramways, with provisions that in such event the Corporation shall be substituted as Promoters of the Tramways proposed to be authorised by the present Order, and shall grant a lease to the original promoters.	5 26	...	18,000
Morecambe	To authorise the construction of additional Tramways in the district of the Morecambe Local Board, on a gauge of 4 feet 8½ inches, to be worked, as well as the lines authorised by the Morecambe Tramways Act, 1886, by animal power, or with the consent of the Board of Trade, by certain modes of electrical power; and to sanction additional capital.	1 31	0 43	7,955
Perth and District ...	To authorise the construction of Tramways between Perth and New Scone, on a gauge of 3 feet 6 inches, to be worked by electricity or by steam or any mechanical power, and to empower the Corporation of Perth, or the Police Commissioners, to acquire the undertaking at any time after the passing of the Act confirming the Order.	0 26	2 49	8,000
Somerton, Keinton-Mandeville, Castle Cary, and Evercreech.	To authorise the construction of Tramways between Somerton and Evercreech, on a gauge of 4 feet 8½ inches, to be worked by animal power, or by steam, electrical, or any mechanical power.	0 62	13 40	21,644

ELECTRIC LIGHTING PROVISIONAL ORDERS.

NAME OF ORDER.	OBJECT OF ORDER.	Capital Proposed to be Expended.
		£
Aberystwith Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Aberystwyth to supply electricity within that borough.	5,000
Ashton-under-Lyne (Corporation) Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Ashton-under-Lyne to supply electricity within that borough.	22,000
Brighton Electric Supply Order.	To authorise the Brighton and Hove Electric Light Company, Limited, to construct and maintain electric lines and works, and to supply electricity within a portion of the municipal borough of Brighton and the parish of Preston.	50,000
County of London (North) Electric Lighting Order.	To authorise the County of London Electric Lighting Company, Limited, to supply electricity within the parish of St. Mary, Islington, the united parish of St. James and St. John, Clerkenwell, the parish of St. Luke, Middlesex, and the district of the Holborn District Board of Works.	50,000
County of London (South) Electric Lighting Order.	To authorise the County of London Electric Lighting Company, Limited, to supply electricity within the parish of Lambeth, the parish of St. George-the-Martyr, Southwark, and the district of the Wandsworth District Board of Works.	50,000
Dublin Electric Lighting Order.	To authorise the Corporation of Dublin to supply electricity within the City of Dublin.	31,000
East London Electric Supply (Hackney) Order.	To authorise the East London Electric Supply Company, Limited, to supply electricity within the district of the Hackney District Board of Works.	100,000
Fareham Electric Lighting Order.	To authorise the Fareham Electric Light Company, Limited, to supply electricity within the district of the Fareham Urban Sanitary Authority.	7,500
Govan Electric Lighting Order.	To authorise the Commissioners of Police of the burgh of Govan to supply electricity within that burgh.	50,000
Halifax Corporation Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the county borough of Halifax to supply electricity within that borough.	53,000
Hampstead (London) Electric Lighting Order.	To authorise the Vestry of the parish of St. John, Hampstead, to supply electricity within that parish.	81,000
Harwich (Corporation) Electric Lighting Order.	To authorise the Corporation of Harwich to construct and maintain electric lines and works, and to supply electricity for public and private purposes within the borough of Harwich.	6,600
Kilkenny Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the municipal borough of Kilkenny to supply electricity within that borough.	10,000
Lambeth Electric Lighting Order.	To authorise the Vestry of the parish of Lambeth to supply electricity within a portion of that parish.	50,000
Limerick Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Limerick to supply electricity within that borough.	13,000
Liverpool Electric Lighting Order.	To authorise the Liverpool Electric Supply Company, Limited, to supply electricity within a portion of the City of Liverpool.	Not stated.
Maidstone Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Maidstone to supply electricity within that borough.	12,000
Newbury Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Newbury to construct and maintain electric lines and works, and to supply electricity within that borough.	8,000
North London Electric Lighting Order.	To authorise the Camberwell and Islington Electric Light and Power Supply, Limited, to supply electricity within the district of the Hackney District Board of Works, the parish of St. Luke, Middlesex, and the parish of Clerkenwell.	150,000
Oxford Electric Lighting Order.	To transfer to the Oxford Electric Company, Limited, the rights, powers, and obligations of the Electric Installation and Maintenance Company, Limited, under the Oxford Electric Lighting, Order, 1890.	...
St. Mary, Islington, Electric Supply Order.	To authorise Messrs. Sharp and Kent, of 34, Victoria, Street, Westminster, to supply electricity within the parish of St. Mary, Islington.	50,000
Sheffield Electric Lighting Order.	To authorise the Sheffield Telephone Exchange and Electric Light Company, Limited, to supply electricity within the municipal and county borough of Sheffield.	28,566
Shoreditch Electric Lighting Order.	To authorise the Vestry of the parish of St. Leonard, Shoreditch, to supply electricity within the said parish.	50,000
South London Electric Lighting Order.	To authorise the Camberwell and Islington Electric Light and Power Supply, Limited, to supply electricity within the districts of St. Olave District Board of Works, and the St. Saviour's District Board of Works, and the parishes of St. George-the-Martyr, Southwark, and St. Mary, Newington.	100,000
Sutton (Surrey) Electric Lighting Order.	To authorise the Sutton (Surrey) Local Board to supply electricity within the urban sanitary district of Sutton.	22,937
Walton-on-Thames Electric Supply Order.	To authorise the Weybridge Electric Supply Company, Limited, to supply electricity within a portion of the parish of Walton-on-Thames.	3,000
Waterford Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the borough of Waterford to construct and maintain electric lines and works, and to supply electricity within that borough.	20,000
Waterford Electric Supply Order.	To authorise the City of Waterford Electric Supply Company, Limited, to supply electricity within the borough of Waterford.	15,000
West Ham (Corporation) Electric Lighting Order.	To authorise the Mayor, Aldermen, and Burgesses of the county borough of West Ham to supply electricity within that borough.	20,000
West London Electric Lighting Order.	To authorise the Putney and Hammersmith Electric Light and Power Supply, Limited, to supply electricity within the parishes of Hammersmith, Fulham, and Battersea, and a portion of the district of the Wandsworth District Board of Works.	100,000
Whitechapel District Electric Lighting Order.	To authorise the Board of Works for the Whitechapel District to supply electricity within that district.	52,300
Woking Electric Supply Company Electric Lighting Order.	To authorise the Woking Electric Supply Company, Limited, to erect and maintain electric lines and works, and to supply electricity within the parish of Horsell, and part of the parish of Chertsey, in the county of Surrey.	200

ELECTRIC LIGHTING BILL.

NAME OF BILL.	OBJECT OF BILL.	Proposed Capital.	
		By Shares.	By Loans.
Sutton Coldfield Corporation (Electricity and Gas).	To authorise the Corporation to produce and supply light by means of electricity within the limits of gas supply, and to borrow money; and for other purposes.	...	£10,000

TRAMWAY BILLS.

NAME OF BILL.	OBJECT OF BILL.	Proposed New Capital.		Length of Proposed Tramways.
		By Shares	By Loans.	
		£	£	M. CHS.
Blackpool improvement.	So far as regards tramways, to empower the Corporation of Blackpool to purchase the undertaking of the Electric Tramway Company, Limited, and to enable the Board of Trade to grant a licence to the Corporation to work the tramways, if the Corporation are unable to demise the same upon terms yielding, in the opinion of the Board of Trade, an adequate rent.	..	...	...
Edinburgh Street ...	To authorise the Edinburgh Street Tramways Company, with the consent of the Board of Trade, to work their tramway by cable or electrical power; to empower the company to acquire, by agreement, other tramways in Edinburgh and Leith; and to authorise the raising of additional capital.	300,000	75,000	...
London County Council (Tramways).	To authorise the construction of tramways over Westminster Bridge and along the Victoria Embankment to the South Eastern Railway Bridge, to be worked by animal power, or, with the consent of the Board of Trade, by electrical power; to provide for an interchange of traffic with the tramways of the London and South London Companies; and to authorise the London County Council to raise money for the purposes of the Act.	...	10,000	double line 0 56 single line 0 2
Newcastle - upon - Tyne improvement	So far as regards tramways, to authorise the Corporation of Newcastle-upon-Tyne to construct additional tramways, partly a doubling of existing lines, on a gauge of 4 feet 8½ inches, to be worked by animal or mechanical power, including electricity; and to enable the Board of Trade to grant a license to the Corporation to work the tramways, if the Corporation are unable to demise the same, upon terms yielding, in the opinion of the Board of Trade, an adequate rent.	...	130,000	double line 13 17 single line 0 44
Newport (Mon.) Corporation.	So far as regards tramways, to authorise the Corporation of Newport (Mon.) to construct tramways, to be worked by animal power, or by steam or any other mechanical power, including cable or electrical power; and to empower the Corporation to work the tramways, and, when acquired, the tramways of the Newport (Monmouthshire) Tramways Company, Limited.	...	25,000	single line 2 65 (with passing places).
North Metropolitan ...	To confirm the purchase by the North Metropolitan Tramways Company of the North London Tramways, and confirming agreements with several local authorities, deferring the periods at which such authorities may exercise the right of compulsory purchase in respect of the North London Tramways; to authorise the construction of additional tramways, on a gauge of 4 feet 8½ inches; to empower the Board of Trade, on the motion of the London County Council, to provide for the interchange and transmission of through traffic in connection with other lines of tramway; to authorise the use of electrical power on certain of the tramways proposed in the Bill; to enable the company to lease tramways belonging to a local authority; to provide and run omnibuses, and to raise additional capital.	160,000	40,000	double line 4 13 single line 0 30
Weston - super - Mare, Clevedon, and Portishead.	To revive the powers granted by the Weston-super-Mare, Clevedon, and Portishead Tramways Act, 1885; to authorise the construction of additional tramroads on a gauge of 4 feet 8½ inches; to provide for the release of the deposit made in 1885; to authorise the use of steam or electrical power, the raising of additional capital, and the sale of the undertaking to the Great Western Railway Company, and authorising the last-named company to apply funds and raise money for their purposes.	20,000	5,000	single line 0 37 (additional tramroad).

LONDON CHAMBER OF COMMERCE AND THE TELEPHONE.

A SPECIAL meeting of the members of the London Chamber of Commerce was held on Monday last for the purpose of considering the present condition of the telephone service and the means for improving it, as well as to discuss the position to be taken in regard to the Private Bills now before Parliament, in which certain compulsory powers are sought by telephone companies for the purposes of their undertakings.

Sir ALBERT K. ROLLIT, LL.D., M.P. (Chairman of the Council), presided.

The CHAIRMAN, in his opening remarks, stated that the meeting had been called for the purpose of considering this question, *i.e.*, the general position of the commercial community in regard to the telephone service of London and the Telephone Bills now before Parliament. He thought, as chairman of the council, that he need not say that what was the feeling of the council was probably the feeling of every member of the Chamber, that the question was not only one of the most importance which could be brought before the Chamber, but that that importance was increasing day by day. Owing to the competition which London merchants and others had to meet in the markets of the world, dispatch was daily becoming more and more an element of business, and very frequently the saving of time was the only means of making a profit. For that reason it became of very great importance to consider whether the methods of communication, of transport, and the like, were all in the most efficient condition, and that the public mind was devoted very much to that question was shown by the Railway Bills which are brought before Parliament, and the Telephone Bills which Parliament is to consider this Session. The Chamber had long taken an interest in the matter. It had appointed one, if not more, committees for the consideration of it, and as some difference of opinion was existing upon those committees, it had been thought desirable that the whole of the members should be called together for the purpose of freely, fully, and frankly discussing that important subject. On behalf of the council he might say that they hoped that it would be discussed fully for the purpose of getting information together on the matter. In dealing with the matter he would point out that he thought one of the first questions they would have to deal with would be whether, considering the importance of communication as an element of commerce, the fullest and best developments had been made to the telephone system in this country under existing conditions, and whether other nations were enjoying greater advantages at a cheaper rate, from that system than were to be had in London. For his own part, the chairman thought he would forbear expressing any strong opinions. He could not help thinking, however, from the experience which he had had in various foreign capitals, that there was undoubtedly a greater development of the telephone there than here, that it was cheaper, and upon the whole more effective, and in addition he could not conceal from himself the fact, that at any rate in America, the long trunk lines were used much more than at home, notwithstanding the fact that at home we are surrounded by the use of the telephone nearly as much as the place to which he had referred. He had the privilege and opportunity of being present at the opening of the line from Paris to Marseilles, and no communication could be easier or more perfect. If it were a fact that they were not quite so much in advance as other countries in relation to the telephone system, they must, he thought, seriously bethink themselves, because if there were one cause of their present commercial position, it undoubtedly had been that, in relation to steam and other matters of that character, we had been in advance of all other nations, and anyone who realised the advantage of the telephone must feel that as an element of commerce we ought to be equal with other countries in the application of electricity to that purpose. Then there was the second question, whether the cost was as cheap as it might be, having regard to the experience of other nations. Many of them could speak with more authority than himself, but he ventured to think that there was room for a reduction of cost in this country. Lastly, there was the most important question probably of all, *i.e.*, whether the system was as effective as it might be, and upon that point he would only say that he had for many years taken personally a scientific interest in questions electrical, and telegraphic, and telephonic. He had the second pair of telephones, apart from any microphones, which were given to him by his friend, Mr. Graham Bell, and what had struck him and nearly everybody, was that the difficulty in regard to the telephone was inductive disturbance. As far as he could judge, he did not think that difficulty could be overcome until there had been a more general use of a second or return wire. It might probably add to the cost, but still the cost of material was being greatly reduced, and as efficiency was the first consideration, he did not think that primary importance would be given to the extra cost if they could get a good service. Then there

was the question of the mode in which the service was conducted. His opinion was that he was bound in fairness to say that there had been a considerable improvement. He did not know that there was very much room for more, but one's temper had not been tried so much recently as in former days. One was bound to say that there had been some advance. Last of all, there was the question of Bills before Parliament. The allegation wherever complaint had been made was that, owing to the absence of powers, they had been unable to give proper facilities in connection with the service. They would have to consider whether such assurances, as had been given by the telephone companies, were satisfactory, that they would consider the public interest first. They had the general principle to bear in mind as to whether it was desirable that compulsory powers should be given to any private company, and lastly, whether it ought to be governed by the Government or private departments. Speaking for himself, it had led one to the conclusion that wherever the Government could be trusted to provide public facilities better and cheaper than individuals could supply themselves, there was a manifest advantage in that public supply. There was a manifest disadvantage in the growth of vested interests, which ultimately had to be bought out at a very serious cost to the community, and if one could really believe that the telephone, as the telegraph system, could be conducted in a manner which would be thoroughly efficient, and if one could be satisfied that it would not be the case as in the Post Office, with too much of the receipts devoted to revenue purposes, instead of being put to the increase of commercial facilities, then he thought there would be a strong inducement to believe that the State ought to do the business in this matter. There was a consideration which ought not to be lost sight of, and that was, that this matter was important, not only directly, but indirectly, as an element of commerce in the cheapening of cost and production. Electrical engineering was a branch of science to which it seemed there could be no limit; many industries were dependent upon it; there seemed to be no limit to the application of electricity in all the departments of life, and therefore a branch of industry which employed almost a countless number of people was one which, for that reason, in addition to the others he had mentioned, should be maintained in the most progressive state in this country. They might say that this great branch of trade underlaid nearly all other trades; there were few trades with which electricity had not at the present time something to do, and therefore it was of vital importance to the community that every advance which was possible should be made so that the public mind might be kept educated on all points, and that the public should have advantage given to it of all progressive improvements. That would be done, in general, through technical education, but whatever they said about education, technical or general, unless the public workmen were educated from public practical life in their shops, it would not make the desired improvement. Unless these arts were widely diffused in the commercial life of the country, they would find other countries leading in the race of commercial competition, and gaining the position which ought in this age to belong to this country. It was a most important question to be discussed, and he hoped it would be discussed with impartiality, and with a disposition to give every credit to private enterprise, which as an element of commercial life would at once be superseded by the State. If the facilities could be properly bestowed, they would not grudge the Government the service; but, on the other hand, where they were dealing with private enterprise worked by the Government, they must insist that the most improved and recent appliances should be given to the public. Those were the positions from which he hoped the question would be discussed.

Mr. F. W. REYNOLDS thought they were severely handicapped in all the markets of the world, and it was a matter of greatest importance to them that they could receive quick and speedy answers to their enquiries. As a merchant, he could only say that to them in their businesses it was a question of quick delivery, and not so much as to price, and they knew perfectly well that if they had the facilities of putting the telephone to work it would be an immense advantage to them. He thought that in this telephone question they could approach Her Majesty's Government. He did not wish to raise complaints about the various companies; he had a private line which worked very well, and whenever it was out of order he had only to inform the company, and they put it right at once. He then moved the following resolution:—

"That, in view of the importance of the telephone industry, and the fact that two separate companies have Bills before Parliament, this Chamber should appoint a deputation to apply for an interview with the Postmaster-General and express the views of the Chamber as to the supreme importance of Her Majesty's Government bringing in a general Bill before Parliament in order to deal with the question of providing means for giving perfect facilities for the development of this industry, not only in the metropolis, but also with regard to inter-town service all over the country."

The motion was seconded by Mr. J. MARTIN.

Mr. JACKSON asked what Bills were before Parliament, and for particulars of same.

The CHAIRMAN stated that there were two Bills, that of the National Telephone Company and that of the New Telephone Company. He then read some particulars from the Bills, copies of which he had before him.

Mr. J. CHAMBERS said that he failed to see the object in applying to the Postmaster The Telephone Committee of the Chamber, with which he was connected, had discussed the matters fully, and had had both the companies represented at their discussions and heard both sides. He then moved the resolution, which the Telephone Committee had proposed, as an amendment to the first resolution:—

"That we are of opinion that an efficient telephone service cannot be given to the metropolis unless statutory powers are conferred upon the companies, and that the council of the Chamber should be requested to take the necessary steps to give effect to this recommendation."

He failed to see that there could be any monopoly in this matter. There were two large companies who were putting forth their claims, and he thought that those companies would see that the commercial world was better served than if they had a Post Office telephone. Regarding the Post Office telephone at Birmingham, he remarked that when the National Telephone Company went down there the Post Office lost a considerable number of their subscribers and men who joined the National Telephone Company? They had had complaints, but how had they arisen? It was because they had no statutory powers. The companies had had to use six miles of wire where there was only three miles necessary, to arrive at the point they wanted. Looking upon it as a commercial matter, if those companies could serve them by getting the statutory powers, and make it effective and answer the people's purpose, as commercial men they ought to strive as much as they possibly could to obtain those powers for them, as far as their influence would assist. He did not like centralising all these things. He would sooner depend upon a private competition amongst the companies themselves, and if one company served them better than another, they would go to that company, and they would try to make their service as good as possible.

Mr. FAITHFULL BEGG seconded the amendment. He did not know whether he had any claim to speak with any authority upon this question, but in seconding the amendment he should like to make one or two remarks. The question of the development of the telephone had resolved itself into the question of whether it was to be done by the Post Office or by private enterprise. He quite believed that the time would come when it would be necessary that the Post Office should control the telephone in this country, but if they were to judge by the past, they had no guarantee that that work would be done within any reasonable period if it were left to a public department. The evidence of that was a fact that when the enterprise began to be opened up, the Post Office intimated that it was willing to undertake the duty, and establish telephonic exchanges wherever called upon to do so, but notwithstanding that, the Post Office was left to-day without any telephonic exchanges of any special importance in this country. Several towns had obtained it by private enterprise. He did not blame the Post Office for that, but he observed that the genius of a state department was not able to deal with such a subject. If on the one hand they said that the companies must develop their system, and the public must have the necessary facilities, and on the other hand denied them the powers they needed, then they were not giving the necessary opportunity for that development, or the cheaper service which was demanded; therefore he said that while in the future it might be necessary that they should take over the telephonic system, it was not reasonable to suppose at present that they would get what they required if they left it to the Post Office. Then they came to the question of the economy of working. There were grave complaints as to the telephonic service in this country, but into this he would not go, but he would point out that the company which was the largest telephone company in this country, and, in fact, the only company which had any large amount of business, was a company which had always carried "economy" upon its banner. It was a fact, moreover, that whereas that company began with high subscription, it gradually reduced its tariff all through Scotland, until to-day, not only in Scotland, but in all the districts of England, the tariff of that company had been reduced at every point to £10, and, in some places, to lower. As regarded the metropolis, it was well known that the conditions were such as did not exist in any other part of the civilised globe. The number of subscribers was very large in any point. It was necessary in London, if anywhere, that there should be statutory powers under which the wires should be carried in the direction in which they should go. He said that, if granted, those powers should be hedged round. They had granted the electric lighting companies the power to open up the streets, and a great deal of inconvenience and mess they were causing. They were now beginning to admit that telephone industry should have powers upon the same terms as the electric lighting companies. The amended resolution, he thought very properly, excluded reference to the Postmaster-General, who was interested, but had business of his own, and he did not see what good they could gain by going to that individual.

The DUKE of MARLBOROUGH said he thought the subject was one with which he hardly knew how to deal. As well as being of enormous importance to the community at large, it was a very intricate question, and in dealing with it he would take the points on the second resolution to which Mr. Begg had particularly alluded, that was, to see the Postmaster-General on the matter. They said that they ought to develop private enterprise in this country, and that statutory powers should be given to the companies. The gentlemen present were not only a Chamber of Commerce, but also members of the Empire, from a point of view that they were all taxpayers, all interested in the position of their public departments. They bought the telegraph at a very great cost to themselves, and were losing a great deal of money over it. Supposing the industry developed, what was to be the effect upon the telegraph? The telegraph would be completely cut out. The Post Office knew that, and was in a position that the Government would have been, had they bought up the gas companies before the electric lighting was commenced. The Post Office were taking a very natural attitude with regard to the matter. He was of opinion that the inter-trunk communication should be in the hands of the Government, and he maintained that no Bill which could be passed for any company would give sufficient powers to it to lay such a system as could be laid by the Government. The Post Office laid systems of tubes in communication with their telegraph lines; they could lay them economically and efficiently, and, in fact, give facilities that could not be got for a private telephone company. He therefore laid it down as a principle that they had the right to suggest approaching the Postmaster, because the interests of the public could not be served unless the Government took up the inter-trunk service. They would not get it cheap; they were bound, as taxpayers, to protect what they had paid

for the telegraphs. He next referred to the question of the Bills before Parliament. There was no doubt that the Post Office had behaved in the most obstructive manner, and he sympathised with the National and United Company. He thought he was not making any breach of confidence when he told them that the Postmaster-General was going to bring in a Bill for the purpose of dealing with the telephone question. What the terms were he did not know, but he knew that it was the intention of the Government to bring in a Bill which embodied the underground principle. On the other hand, they knew that both the private Bills were to be opposed by the Government. It was really an unfortunate thing that the Government should oppose these Bills at the earliest stage. He thought they should be allowed to pass to committee and be discussed in a similar way as it was then being discussed. The public would then be able to decide as to what should be done. He thought it unfair that the Bills should be thrown out before they had had a chance. It was absolutely necessary that the Chamber of Commerce should take some active line and represent its views before the Government, otherwise the companies themselves were perfectly powerless in getting a Bill carried. The first resolution was an important one, and was an expression of views on the part of the Chamber asking for an interview between them and the Postmaster, and that they attached considerable importance to the development of this industry, and wished to obtain his views. There was then the question whether the Government could do the work of distribution, and the argument that he used, and he thought it was a reasonable way of looking at the matter, was that abroad, as they knew, it was a monopoly and in the hands of the Government. It suited foreigners but not Englishmen. They did not want to go to the Government, to send to the Post Office, if their wires broke. He spoke absolutely from no interest excepting having given considerable attention to the question. The Government should be as a farmer who sent his milk churns to London, and employed dairymen to deliver it to the different houses Having dealt with the question of the Postmaster-General's attitude, and the Bills before Parliament, they came to the question of compulsory powers. Parliament would never give statutory or compulsory powers to private companies. There had been several instances which had not been at all satisfactory, and the power of breaking streets would never be given to provisional orders, but they were all given under the Electric Lighting Act. They could not pass a General Act for the purpose of telephones, the only way they could get it was by acting under a General Act of the Electric Lighting Act, that was, to get the telephone companies to make arrangements with the electric lighting companies, or get the Government to do it themselves. Parliament never would consent, and therefore they need not consider the question of statutory powers; it was really no use bringing it before Parliament. They would not hear of it. Regarding the possible cost of telephone subscribers, he said that there was no doubt that they had paid very dearly for the telephone; £20 a year was too much to pay for it in London. He did not wish to make any rash statements, but he said that £12 was a proper price on the twin-wire system. It could be done on the twin-wire system for about £12 a year. They ought to be able to talk for their £12 to any part of the provinces. Regarding twin wires, if the room they were in was a little village, there would be no necessity for a twin wire, but in town it was absolutely necessary. They could not talk on the telephone in a town unless they had closed circuits on the twin-wire principle. They could talk from London to Birmingham or Glasgow if they had a twin wire, but not without. He had something to do with the electric light in this city, and knew what conditions there were, but as compared with the electric light the telepone was mere child's play. It was perfectly possible to give them a service, so that they would get through to six or more people in the course of a few minutes. An eminent patent lawyer, a man in enormous practice, and thoroughly up in the whole electrical science, said to him the other day, "Bad as this system is, it is worth £1,200 a year to me in my professional trade." There is no doubt that that was true, and in their offices and in their homes, if they could have a telephone they would be saving in the letters they wrote and the journeys they made and the business they transacted. Therefore he said it was a most important question. He urged upon them that the first resolution was a very important one. With due respect to the resolution, which was the resolution of the Committee of the Chamber, he thought it was no use their pursuing it. Parliament would not grant——

Mr. CHAMBERS, rising to order, said that the resolution did not specify that any special powers were given to any particular companies. It was open to companies whether there were two now or a dozen afterwards, that they should by [the same means that they came under the Act, have power to carry out their system for the convenience to the commercial world.

Mr. FAITHFULL BEGG said that that was his undertaking in seconding it.

The DUKE OF MARLBOROUGH, continuing, said that he thought they were not at variance; Parliament would not give any private companies, whether there were one or many, these powers. They were all very much in the dark. They all wanted to know what was going to be done, and the only means of finding out what was to be done was for the Chamber to approach the Government and say in so many words that they wanted the development of this industry, and to say that if Parliament, in its pleasure, did not approve, whether it will grant such facilities under a general enabling Act as the Electric Lighting Act, which would allow the industry to grow and prosper.

Colonel RAYNSFORD JACKSON (Chairman of the National Telephone Company) stated that he had listened with great interest to the lucid form in which the chairman put before the meeting the questions that it would be called upon to discuss, and he hoped he would be allowed to deal with a few of them seriatum. First of all, he wished to allude to the motions and amendment before the meeting. For his own part, he did not mind whether the motion or amendment were carried, because the purpose of both was practically the same, namely, to secure statutory powers under which the companies would be enabled to do their work under a general Act. The National Company, although it did 83 per cent. of the telephone business of the country, did not ask for special powers on behalf of its own company. His belief was that such statutory powers as one company might possess ought to be given to all, and he thought that both the resolution and the amendment would lead to that conclusion, but he thought the amendment put the point much more pithily, because it asked simply that some General Enabling Act should be passed by Parliament, and that the resolution which was passed by the telephone committee of the Chamber should be accepted by the meeting of the Chamber, and presented to Government as indicating the view of the Chamber, and he did not think that a resolution of that kind put before the Government, and passed by a body of men so influential could otherwise than meet with respectful attention. Sir Albert Rollit alluded to the cost of the telephone, the Duke of Marlborough did the same, but gentlemen were not aware that, although the telephone was given to the public much cheaper in some countries than it was here, it could be worked for much less in other countries than here. He had been in Germany, and seen the telephone system at Dresden and Berlin. Owing to the assistance of the English Ambassador there he was permitted to pass through the Berlin Exchange system, and had every information given to him about every particular in connection with it. There they had 17,000 subscribers, and in London there were only half the number, but why could it be given cheaper there than here? It was in the hands of the Government, had no way-leave charges, and had exchanges in such parts of Berlin as was considered best, and had wires for 6,000 subscribers at each exchange. The wires were run from exchange to exchange upon closed lines. There was no royalty to pay of 10 per cent.; there were no way-leave charges, where a mile of wire would do, only a mile was run. He hardly ventured to tell them, what they were paying in London for way-leaves, but it was over 30s. per subscriber. They paid £2 to the Government for royalty. They ran 1½ or 2 miles of wire where a mile would do. Where they had completed a route they were ordered to remove their standards from the top of the buildings, and, at great cost, they had to take a circuitous course to complete the connection; and when Sir Albert and others suggested that there should be a reduction of the rates, he would tell them that it was consistent with the principles of the National Telephone Company that the cost should be reduced. There was a very large reduction in the provinces the year before last, and that reduction had much encouraged the National Telephone Company to prefer a lower to a higher tariff, but what was the position in London? It was with the utmost difficulty that they could find wayleaves to run lines in London; a large number of people would not even have telephone facilities, the company could not put them up, and until some such resolution as that were passed it would be utterly impossible for that company to lower its tariff in London, and thus cause disappointment all round. Let them have statutory powers to do their work as it ought to be done, and then the consideration of the reduction of tariff could be dealt with in earnest. Then there was something said about the inadequacy of the service given in London. (Hear, hear.) That "hear, hear" responded to his own experience. He concurred with the sentiments which had been uttered. When the National Telephone Company took over the system of the United Telephone Company, it found that a general reconstruction was necessary. The Duke of Marlborough, in a letter to the *Times*, stated that the National Telephone Company had two exchanges, one in Cannon Street and one in King Street, and that it was struggling to connect as it best could, with wires, and to loop those wires, convert them into twins, and get over the difficulties in that way. The Duke was not adequately informed upon the subject. They had not two exchanges, but 22, and they were scattered over a huge area, and the object of the company, its first effort, was to connect the 22 exchanges with such a number of wires as would enable the subscribers to talk with rapidity to the subscribers in other parts, and as the distance between many of them was very great, the company resorted to converting the junction wires into twins. The company undertook a great many other things that it was extremely difficult for it to do, in consequence of the wayleave difficulties. If he were to enumerate them all, he would keep them too long. In the middle of January, after struggling for more than two years to get a sufficient number of wires, they succeeded in connecting and running a somewhat adequate number of wires, and they were attached to a new switchboard specially constructed for the purpose, and placed at Cannon Street, the result was that the service had improved; but the Duke of Marlborough was not mistaken when he thought that they recognised the fact that metallic circuits were a necessity for a perfect system. Recognising that fact nearly two years ago, they applied to the Commissioners of Sewers to give them permission to put pipes underground in the City, which contained two-thirds of their subscribers; they further sought to centre the six City exchanges into one. Had the Commissioners of Sewers given them the sanction which they asked, they would have been a long way on towards the adoption of the metallic loop in the city, and the subscriber's message would have to go through only one exchange, and as soon as they obtained the powers which they sought, that was the work they would take in hand. In addition to that looping, they were looping the metallic wires in the suburbs. They had completed Croydon and Sydenham, and they were taking them in turn as their men could take them in hand. The public was under a great misapprehension when it thought that they had not the benefit of a metallic circuit system in London, because the company did not give it. It was because they could not give it. A good deal had been said about the twin wire and the single wire system as a general

factor in efficiency. He wished to point out that throughout Germany, even in Berlin, where there were 17,000 subscribers, they had a single wire system entirely. In Austria they had a single wire system, and in France they had the same, everywhere but in Paris, and there the Construction of the Sewers invited the adoption of an underground system, and therefore a metallic circuit was a necessity. Regarding the matter of the Post Office, he stated that where the Post Office and the telephone company were in conflict in the provinces, where a single wire system had been adopted, the company had had the monopoly. Sir Albert Rollit touched upon the Bills before Parliament, and he would thank him for his lucid statements. He would also thank Mr. Chambers for the resolution, which was in harmony with what had been done by the committee. The Duke referred to the telephone trunk wires, thinking that this ought to be in the hands of the Government. The National Telephone Company had 20,000 miles of trunk wire, and various towns in the provinces, in Lancashire, in West Cumberland, and throughout Scotland, were connected to each other, and 10,000,000 messages a year passed through them. When the Duke said it ought to be in the hands of the Government, he (Colonel Jackson) as connected with the National Telephone Company, said that it was of immense importance to them. It would be a very long time before any rival would be able to give Manchester the power of talking with Sunderland, and London, and Birmingham, and Sheffield, and therefore they had, owing to their whole enterprise, got an advantage which they did not think ought to be taken from them by the transfer of the telephone system to the Government.

Mr. PROVAND, M.P. (chairman of the Mutual Telephone Company, Manchester), in the course of his remarks, spoke of the efficiency and cheapness of the Mutual system at Manchester, stating that their rates were £5 to their shareholders and £6 to non-shareholders.

Mr. Sheriff FOSTER stated that he had no interest in any of the existing companies; he merely appeared there as a subscriber to the telephone. He expressed dissatisfaction at the way in which the subscribers were served in London. He thought they got the very minimum of efficiency at the very maximum of cost.

Mr. MORSE and Mr. JACKSON having briefly addressed the meeting,

The CHAIRMAN suggested that probably all views would be met if the resolution was put in the following form:—

"That in view of the importance of the telephone industry, and the fact that two separate companies have Bills before Parliament, this Chamber should appoint a deputation to apply for an interview with the Postmaster-General, and express the views of the Chamber as to the supreme importance of Her Majesty's Government bringing a General Powers Bill into Parliament, so as to confer facilities for the development of the telephone, not only in the metropolis but also with regard to inter-town services all over the country, whether by private companies or by the Government.

This was agreed to, the amendment being withdrawn.

Names were then proposed to form the deputation. The chairman stated that these names would be brought before the council:—Duke of Marlborough, Colonel Jackson, Sir Albert K. Rollit, LL.D., M.P., Mr. Faithfull Begg, Mr. Provand, M.P., Mr. A. R. Bennett, Mr. F. W. Reynolds, Mr. Sheriff Foster, Mr. Morse, Mr. Thompson, Mr. Jackson.

The meeting then terminated.

NEW PATENTS—1892.

2,365. "Improvements in electrical communicating apparatus for mining and other works." A. F. MABON. Dated February 8th.

2,393. "Improved method of and appliances for using electricity as a medicinal agent." W. GRIGG. Dated February 8th.

2,396. "An improved microphone or transmitter." J. H. KINDLE. Dated February 8th.

2,397. "Electric fire alarm." E. D. WISE. Dated February 8th.

2,412. "Improvements in automatic disconnectors for overhead conductors." A. L. JOHNSTON. Dated February 8th. (*Complete.*)

2,417. "Apparatus to gather and store electricity or energy from water, the earth, or from the atmosphere." R. J. CROWLEY. Dated February 8th.

2,438. "Improvements in relays for submarine telegraphy." G. SACCO. Dated February 9th.

2,448. "Improvements in and connected with the arrangement and operation of relays in telegraphic systems." W. F. WENTZ. Dated February 9th. (*Complete.*)

2,486. "Improved composition of matter suitable for use in the manufacture of journal bearings, packings, projectile rings, commutator brushes, and various other articles where surfaces come into frictional contact, and for conductors of electricity." P. H. HOLMES. Dated February 9th. (*Complete.*)

2,488. "Electric lighting system." S. L. TRIPPE. Dated February 9th. (*Complete.*)

2,497. "Improvements in magneto-electric machines." J. HUNT. Dated February 9th. (*Complete.*)

2,540. "Improvements in the arrangements of conductors for electric traction." J. E. WALLER. Dated February 9th.

2,541. "Apparatus for and method of recording the time during which telephones, phonographs, and other instruments or machines are in use or at work." B. H. C. BOGLER. (Communicated by K. Strecker, Germany.) Dated February 9th.

2,544. "Improvements in electrical motors." A. J. BOULT. (Communicated by W. J. Still, Canada). Dated February 9th. (*Complete.*)

2,588. "Improvements in telephonic switching apparatus." E. F. FURTADO and C. B. OAKLEY. Dated February 10th.

2,601. "Improvements in apparatus for use in suspending overhead wires, and for cutting or removing obstructions on such wires." J. HOWARD. Dated February 10th.

2,606. "Improvements in the electro-pneumatic action of organs." R. G. GOATCHER. Dated February 10th.

2,618. "Improvements in electromoters." P. BARY. Dated February 10th.

2,619. "An improvement in the electro-plating of organic substances." A. L. C. DE LAUTREPPE. (Communicated by H. Pottier, France.) Dated February 10th.

2,621. "An improved telephone combination." Sir C. S. FORBES. Dated February 10th.

2,646. "Improvements in telephonic transmitters." L. LARRANAGA. Dated February 11th.

2,652. "Improved regulator for voltaic arc lamps." F. KLOSTERMANN. Dated February 11th.

2,653 "Improvements connected with electrically operated coin-freed apparatus." H. E. LANGLEY. Dated February 11th.

2,690. "Improvements in electric arc lamps." H. TIPPING. Dated February 11th.

2,722. "Improvements in electric switches." A. L. SHEPARD. Dated February 11th.

2,724. "Improvements in electro-therapeutical apparatus." A. GRIMM. Dated February 11th. (*Complete.*)

2,727. "Improvements in telephone receivers." O. IMRAY. (Communicated by F. Gross, Canada.) Dated February 11th.

2,733. "Improvements in and relating to the driving and controlling of riveting, shearing, punching, and other machines by electricity." A. PIAT. Dated February 11th.

2,738. "A new relay with alternate currents for long-distance submarine cables." G. SACCO. Dated February 12th.

2,743. "The application of electricity to a scientific puzzle." A. S. FIELD. Dated February 12th.

2,744. "Improvements in telephonic instruments." B. HOFFMAN Dated February 12th. (*Complete.*)

2,748 "Electro-heliograph suitable for interastral communication." R. J. CROWLEY. Dated February 12th.

2,762. "Improvements in or relating to electrical signal apparatus for indicating the position of railway switches or points." W. P. THOMPSON. (Communicated by P. Schwenke, Germany). Dated February 12th. (*Complete*).

2,775. "Improvements in ozonising or electrifying atmospheric air or other gases." R. A. P. TAUNTON. Dated February 12th.

2,784. "Improvements in or relating to sockets and switches for incandescent lamps." J. C. MEWBURN. (Communicated by D. H. Piffard, United States.) Dated February 12th.

2,785. "Improvements in incandescent electric lamps." J. C. MEWBURN. (Communicated by D. H. Piffard, United States.) Dated February 12th.

2,791 "An improved time-registering device for electric currents." W. COBB, jun., and W. D. WILDER. Dated February 12th.

2,831. "Improvements in apparatus for the driving of chronometric balances and pendulums for electricity meters." J. OULTON and J. EDMONDSON. Dated February 13th.

2,849. "Improvements in and relating to electrical devices for operating railway points." W. P. THOMPSON. (Communicated by E. Klatte, Germany.) Dated February 13th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

10,252. "Improvements in electric railways." J. P. BAYLY. (A communication from abroad by T. A. Evans, of San Francisco.) Dated July 2nd. 8d. Relates to electric railways of that kind or construction in which a tube, laid underground, has a slot along the top for the shank or carrying bar of the current collector, and the electrical conductor is laid along the tube against the top or roof, and to one side of the tube-slot, being insulated from adjacent parts by a block. A depending apron or partition is fixed along the tube, between the tube-slot and the conductor, to shut off that part of the tube-space for almost the full depth of the tube from the centre portion into which the tube-slot opens. The current-collector travelling on and in electrical contact with the conductor, is fixed on the end of a carrying-bar, which is mounted on the motor-car, and the bar is formed with an offset or bend at the lower end, forming a laterally-extending foot to pass beneath the bottom of the apron and project into the space inside, where the conductor is laid. 1 claim.

19,740. "Improvements in column printing telegraph receivers." F. H. W. HIGGINS. Dated December 3rd. 11d. The present invention is directed to the bringing back of the type wheel back into position to commence another line independently of the driving train by which the type wheel is propelled. 4 claims.

20,175. "Improvements in electric meters." A. FRAGER. Dated December 10th. 8d. Relates to modification in specification No. 8,958, of 1889, by which the inventor is enabled to employ his apparatus as an ampère hour meter, and also to apply it as an ohm hour meter for indicating nominal energy, that is to say, for indicating independently of the variations of tension of the current

which is supplied the total candle-power of a set of lamps, this candle-power being reckoned at a uniform standard value per lamp. 2 claims.

20,360. "Improvements in electric meters." THE ELECTRIC METER COMPANY, LIMITED, and T. PARKER. Dated December 13th. 8d. Consists of a combination of an ammeter with an arrangement constructed on the principle of a pedometer and clockwork, these being dependent on each other, the clockwork supplying the motive power whereby the mechanism is driven subject to regulation effected by means of levers, the action of which is controlled at certain intervals of time by a suitable ammeter, the index pointer of which is specially shaped for the purpose. 2 claims.

1891.

5,343. "Improvements in electric arc lamps." J. BROCKIE. Dated March 25th. 6d. Relates to a simple, strong, and compact construction of the framework for electric arc lamps, offering facilities for the use of double or multiple carbons and for the general manipulation of the lamp, all the working parts of which are protected. 4 claims.

5,548. "Insulated electric conductors." J. D. BISHOP. Dated March 31st. 6d. The inventor applies an insulating material preferably in strips spirally around the conductor in such a manner, that instead of overlapping on itself in successive convolutions, air spaces are established between the sides of the spiral by giving the thread of the spiral such a pitch, that the edges of the strips cannot overlap, but will be separated by a wide space. When a sufficient thickness of a spirally wound material has been produced, the protective envelope or sheath is applied to the conductor, which is then complete.

1,969. "Improvements in electrical signalling apparatus." H. H. LAKE. (Communicated from abroad by S. J. Burrell, of New York.) Dated February 3rd. 8d. Relates to that class of electrical devices primarily designed and used for establishing, by the manipulation or operation of suitable mechanism at one station, electrical communication between such station and any other, along the line of a given circuit upon which both are located. 7 claims.

1,987. "Improvements in electric lamps." A. M. CLARK. (A communication by J. W. Easton, of New York.) Dated February 3rd. 8d. Has for its object the production of an arc lamp, simple in its construction, both in its electrical and mechanical features, positive and reliable in its operation, and capable of being cared for by comparatively unskilled persons. 7 claims.

3,331. "Improvements in secondary or storage batteries." S. C. C. CURRIE. Dated February 24th. 8d. In producing elements embodying the invention, use is made of woven tubes of asbestos or other suitable material. These tubes are placed upon a brass rod provided with a shoulder adapted for their reception and with a tapering projection or core of less diameter than the interior of the tubes, so that a space is afforded between the core and the inner walls of the tube. This space serves as a mould into which fused chloride of lead, or salt or salts of other metals or materials is or are poured. When the mass has become cool the brass rod is withdrawn, leaving a cavity or matrix in the centre of the cast mass. A series of these partially completed elements is then placed in a suitable appliance or mould, and molten lead or other suitable metal is poured into the cavities or matrices formed by the withdrawal of the brass cores, and which constitutes a central conducting support for the elements. 9 claims.

CORRESPONDENCE.

Lithanode and the Electrolysis of Chlorides.

In the article on "Electrolytic Caustic and Bleach," reproduced in your last issue, Mr. James Swinburne, referring to the difficulty of finding a permanent anode, says :—"Professor Fitzgerald's invention of 'lithanode,' even, does not seem to present a solution of the difficulty; for free hydrochloric acid reduces peroxide of lead, and there is always some liberated at the anode."

It is a fact that lithanode, like ordinary peroxide of lead, when simply immersed in a (cold) solution of hydrochloric acid, becomes partly converted into chloride of lead, according to the equation :—

$$x \,.\, PbO_2 + y\ H\ Cl = \overline{(x-1)\ PbO_2 + PbCl_2} + (y-4)\ H\ Cl + 2\ Cl + 2\ H_2\ O,$$

from which constituent sulphate of lead and water are omitted.

But if this partly-converted lithanode be made an anode in an electrolyte of (say) water acidulated with sulphuric or with hydrochloric acid, it becomes speedily restored to its original condition, with evolution of chlorine at the anode and hydrogen at the cathode, thus :—

$$\overline{(x-1)\ PbO_2 + Pb\ Cl_2} + 2\ H_2O = x \,.\, PbO_2 + 2\ Cl + 4H.$$

This being the case, it is obvious that lithanode may be used as anode in presence of hydrochloric acid without being acted upon (*i.e.*, so long as the current passes).

In the electrolysis of earthy chlorides, the lithanode may, practically without detriment, be left in the solution for an indefinite period after the cessation of the current.

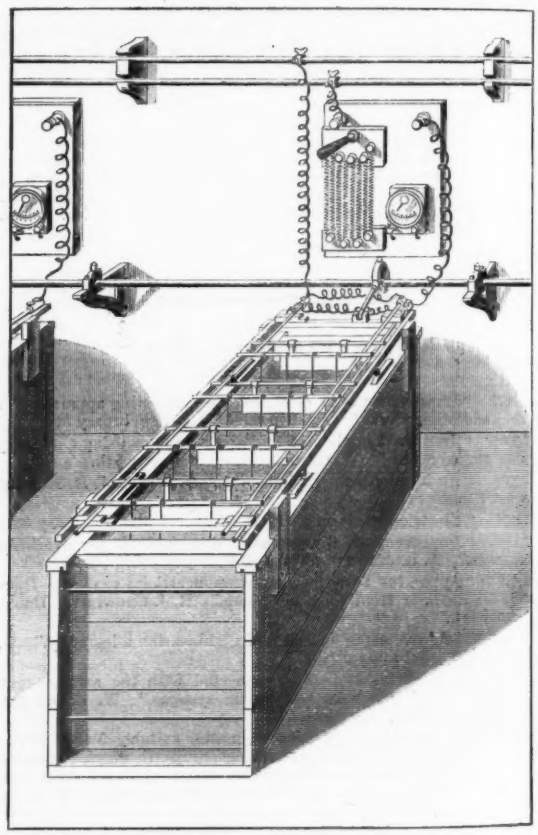
It will be seen that there is but little to fear from the effect of acids upon this anode. In alkaline solutions, however, lithanode becomes rapidly disintegrated.

Desmond G. Fitz-Gerald.

P.S.—What have I done that Mr. Swinburne should call me "Professor"? I am no more "Professor" than Mr. Swinburne himself, or my friend Mr. J. T. Sprague.

AN ELECTRO-DEPOSITING VAT.

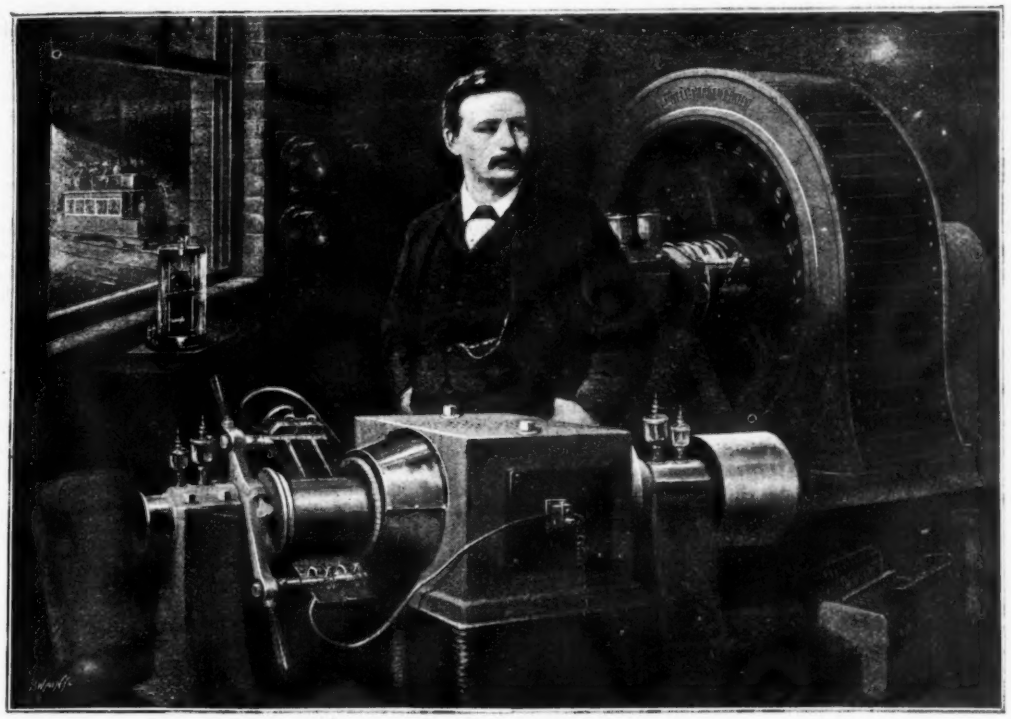
THE London Metallurgical Company, Limited, is using vats constructed as shown in annexed illustration for various electro-plating solutions. The vat is arranged for small work but it can be used for large articles by removing the short cross rods and arranging the work and anodes longitudinally. One advantage of using rods instead of copper tape fixed to the rocking frame is, that they can be readily removed for cleaning, thus avoiding the risk of dirt entering the solution. The rocking frame has a travel of 3 inches, rise and fall of $\frac{3}{4}$-inch, the number of reciprocations being about 22 per minute.



AN ELECTRO-DEPOSITING VAT.

The firm is also depositing iridium, which should have many useful applications, as it is in itself practically unaffected by acids, is exceedingly hard and yet elastic. These valuable properties should render it especially suitable for coating such articles as electrical contacts the working parts of delicate machines, and for many other electrical purposes.

CRYSTAL PALACE ELECTRICAL EXHIBITION, 1892.



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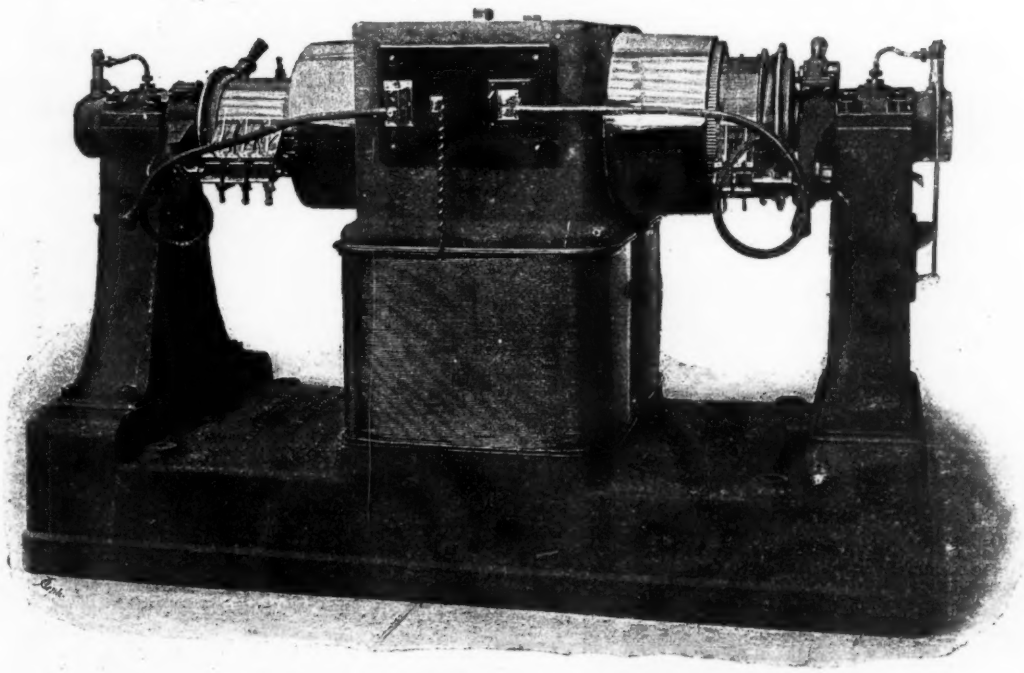


ELWELL-PARKER CONTINUOUS CURRENT TRANSFORMER.

Continuous Current Transformers.

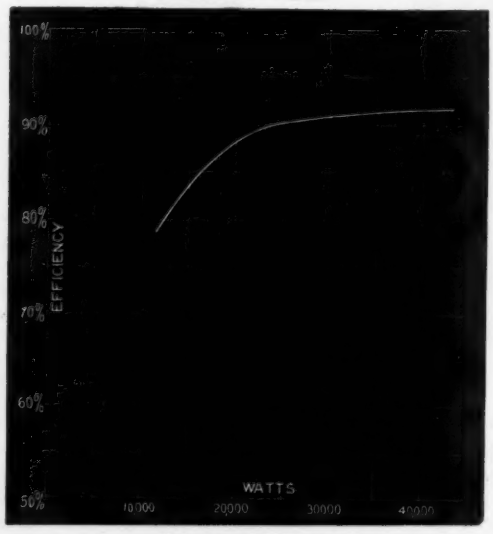
PERHAPS the most important developments in dynamical electricity at the Crystal Palace Exhibition will be found at the stand of the Electric Construction Corporation. Arranged alongside the new continuous current transformer, is an Elwell-Parker alternator, and an ordinary continuous current dynamo.

The continuous current transformers and the system of connection with the central station are of special interest at the present moment, when several companies who have adopted the low tension continuous current system are face to face with the difficulty of reaching consumers, beyond a comparatively small area.

Where the area of supply in such cases is very populous, and the demand for electric light very large, this difficulty

has been met by the erection of new stations independent in themselves, but connected with the ordinary network. By the adoption, however, of continuous current transformers, an extension of area, or of the number of consumers, can be made by adding at the central station high tension continuous current dynamos, supplying current at say, 1,000 volts. By a comparatively economical system of high tension mains this current is conveyed to the part of the low tension network requiring a better supply, and is there transformed to the pressure necessary for maintaining a constant voltage throughout the system. Thus the same object is practically attained as if a new and independent station were erected at this transformer point, and with the better result that all the power and engineering staff is still located at the orginal central station. Where, however, as in most of our provincial towns, the original area of supply is the centre, and extensions are made from time to time to outlying parts, the extremities of the mains are generally reaching districts not over populous and widely distant from each other. In such cases independent stations would generally be quite out of the question, entailing, as they would, enormous expense in proportion to the small part of the network which would be affected by them. We recently described a plan on these lines which is about to be adopted in Oxford. In this case the local authorities, in giving their sanction for the electric lighting of the town, stipulated that continuous currents should be employed, and as the most desirable site for the generating station, with a view to water and coal supply, &c., was situated at a distance of about 1,200 yards from the centre of the area to be supplied, a high tension converter system became necessary, and 1,000-volt continuous current generators with continuous current transformers to convert to 100 volts and feed into a network of secondary mains, were adopted.

We illustrate the Elwell-Parker continuous-current transformer which is similar to those shown at the Exhibition and used by the Crystal Palace District Electric Lighting Company for supplying current to the various exhibits. This machine has two distinct windings, the secondary giving an E.M.F. of 110 volts, and 360 amperes, and the primary winding giving 1,000 volts, when running at a speed of 550 revolutions per minute. In this case the field magnets are excited previous to starting the machines, and to do this effectually the field of the first machine is excited by a current from accumulators. A high-tension current is switched on to the brushes through a resistance. The secondary circuit is afterwards switched on to the feeders, a portion of this current being taken to excite the field magnet of the next machine. The bearings are supplied by special oil pumps so as to give ample lubrication and enable machines to run continuously without attention. These machines have been supplied to the Sydenham and



EFFICIENCY CURVE.

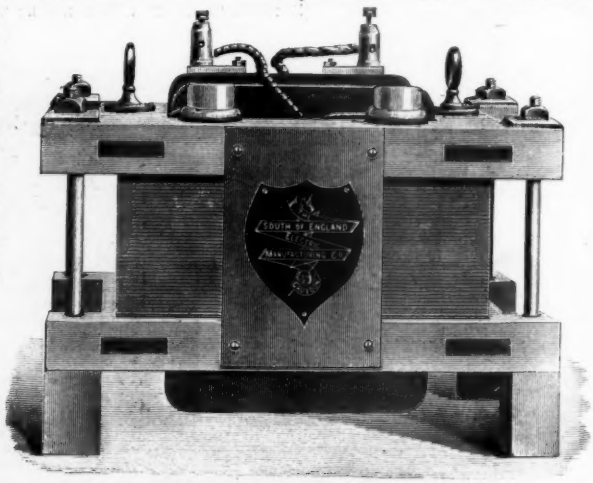
District Electric Light Company, the Liverpool Electric Supply; and the Corporation is building machines for the Oxford Lighting Company.

The efficiency curve of this transformer may be of some interest to our readers. It will be seen that the efficiency at half load is claimed to be over 87 per cent., while at one-quarter load the efficiency is given at 78 per cent.

By permission of Mrs. Lewis we illustrate the painting by the late Mr. Goodwyn Lewis, which was painted for Mr. James Oddie of Ballarat, for presentation as an historical painting to the Art Gallery at Ballarat. There will be little difficulty in recognising Mr. Parker, the works manager of the Electric Construction Corporation. The machines represented are the standard types. The alternator in the picture is one of the machines delivered to the Melbourne central station, and the continuous-current dynamo is similar to the one sent to the School of Mines, Ballarat. The transformer, accumulator, and instruments in the picture are the usual productions of the Corporation. The electric tramcar in the distance is intended to represent the first car of the Birmingham installation by accumulators. This picture was exhibited at Wolverhampton and Melbourne, and is now hung in the Art Gallery at Ballarat.

The Croydon Transformer.

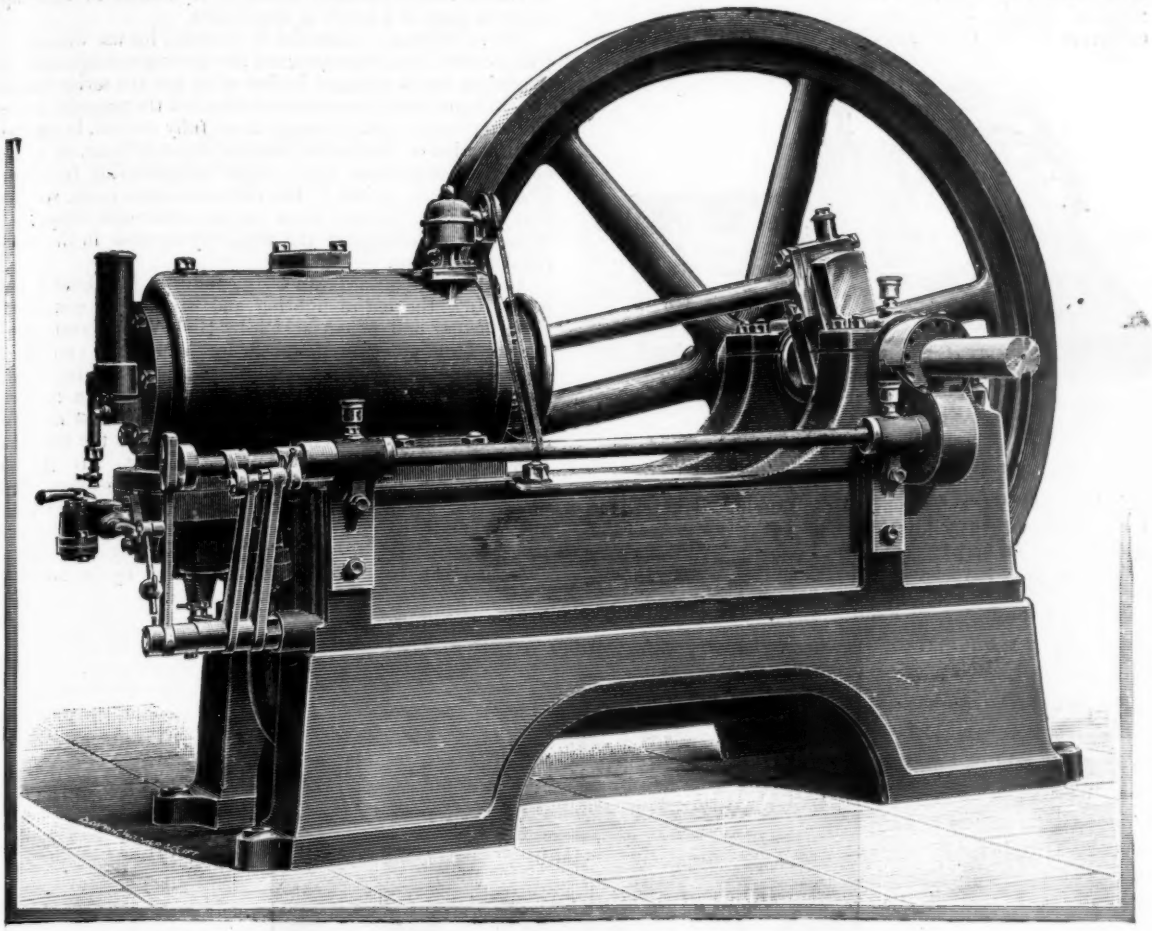
In this transformer, which is made by the South of England Manufacturing Company, the primary and secondary coils are wound upon a mahogany bobbin which is previously boiled in a mixture of resin and wax to prevent the absorption of moisture. The secondary winding is wound first and the primary outside in order to secure greater radiation from the primary; but the form is not generally liked as it increases the liability of damage to the primary coil. The insulation of both the primary and secondary is double cotton. After each layer of the primary is wound it is soaked in oil and is then covered with a layer of shellaced calico. In the new T-type of transformers both the primary and secondary windings are split into two halves for connection either in series or parallel, thus adapting them either for 2,000 or 1,000 volts primary and either 100 or 50 volts secondary. The primary (2,000 volt) winding is divided half-way between its first and last layer with a sheet of vulcanised



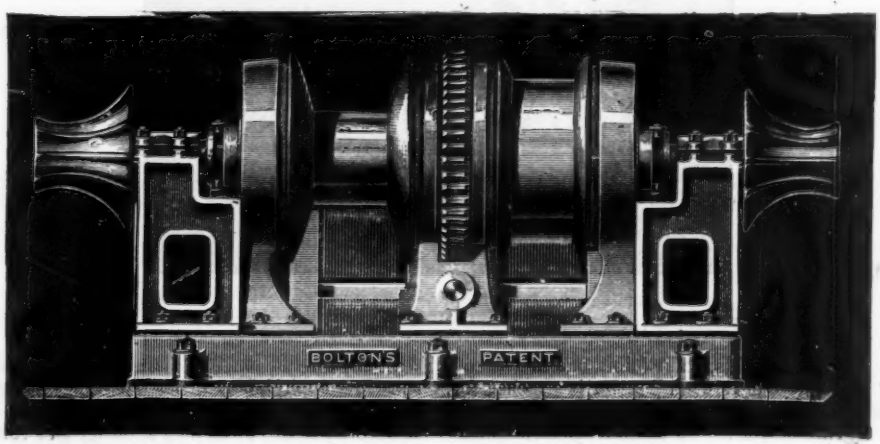
THE CROYDON TRANSFORMER.

fibre and one of either India-rubber or ebonite. The same insulation is used between the primary and secondary. The iron stampings are of E-form with an I-piece placed to fill up the gaps; they are inserted alternately from each end of the bobbin, all the stampings, which are of 28 gauge, are insulated with shellac varnish and paper. The flanges of the bobbin are allowed to project a little from the surface of the coils in order to allow either of a few turns being wound on with a view of raising the voltage of the secondary, or a few neutralising turns with a view to lowering it, according to its position in the district where it is used, and the drop in potential on the mains. The frame is of seasoned oak, bolted together at the corners, and between these the stampings are compressed. By these means the induced (eddy ?) currents, which though negligible in themselves, but which all go to lower the productiveness of a central station, are said to be entirely avoided, and for this reason the company has eliminated all heavy castings or other metallic circuits from their transformers. They prefer invariably to place the transformers either in a thick glass or stoneware tank for the same reason,

but in consequence of requests they have designed a galvanised tank with a widened mouth to allow for the primary and secondary fuses, and any other arrangements that may be required, being placed there, so that the transformer may be lifted out without disturbing them. The transformers exhibited are designed for ordinary periodicities of from 80 to 100, now in general use in England; but a much lower periodicity is preferred, and it is proposed before the close of the Exhibition to show transformers running at about 20 per second.



TRUSTY GAS ENGINE.



ELECTRIC WINCH.

The "Trusty" Gas Engine.

This is an engine of the usual four cycle type, but is very different from the "Otto" in many points. The design is compact, with plenty of metal put in for solidity, and the special features are the simplicity of valve arrangements, the facilities for examining every part, and the perfect and simple governor; this latter consists of an L crank with a ball and thumb screw. The ball acting as a pendulum controls a hit and miss, the speed being altered by lowering and raising the ball. The back end of the cylinders in these engines are made with covers so that the valves may be looked at with the greatest ease, and this has enabled the makers to adapt it as an oil engine for using paraffin and petroleum, and some authentic trials have been made which gave remarkably good results. A most noticeable thing in the "Trusty" gas engine at the exhibition is that although it has one fly-wheel the engine runs perfectly steady.

Messrs. Weyman and Company, the makers, are repre-

sented at the exhibition by Messrs. Appleton, Williamson and Burbey, who are the London agents for this engine.

Woodhouse & Rawson's Exhibits.

Amongst the firms which may be considered as representative of almost every branch of the electrical industry, we may mention Messrs. Woodhouse and Rawson. Their large collection in the nave shows heavy machinery, telephones,

CLOCK CUT-IN.

switches, and not a few novelties. Leaving, however, for the moment their general exhibits, we will notice some of the apparatus which may be of interest.

The company have lately undertaken the manufacture of Bolton's Patent Electric Winches, and exhibit one in action. The axle of a "Woodhouse & Rawson" motor is attached to worm gearing which reduces the speed to the required limit. These are specially suitable for use on board ships on account of their noiseless action. The winch consists of an electric motor, which is geared on to a centre gear drum. At each end of this drum, which is always revolving, the hoisting drums are gripped by friction. The only work the man in charge has to do is to put these drums in or out of gear. When in gear the load is hoisted and when out it is lowered by gravity.

A novelty just introduced is a contrivance for switching in an electric circuit at any pre-determined time. A clock is set to a certain hour, and it is so arranged that its movements release a pivoted arm which, when free, fall into two mercury cups, and make electric contact. This is very useful in many instances where it is desired to light up different parts of a house at fixed hours.

The switchboard illustrated is intended for use with compound-wound electro-motors, and the locking arrangements of the switch are so arranged to first of all put the series wound coils in a position to increase the strength of the magnetic field; and afterwards, when the magnets are fully exerted, to reverse the direction of the flow of current through them, so as to allow them to perform their proper compounding function. The handles are locked by the vulcanised fibre rings, so that it is impossible to turn them in any other order than that necessary for performing the necessary changes in the electrical connections.

Another switchboard which is exhibited is intended for controlling the entire lighting and driving by motors of their factory and offices at Cadby Hall, West Kensington. It has been specially designed for supplying two main circuits, one for lighting and the other for driving (each entirely independent of the other), and in such a manner that any one of three compound wound dynamos may be coupled to either main circuit in parallel with the machine which may be working on that circuit. It is so arranged, by means of special locking switches and plugs, that no machine can be switched in parallel with another until its shunt circuit is made and the necessary plugs inserted or withdrawn as the case may be; and no alteration can be made to the connection by the machine with any circuit, until its main switch has been turned off—thus absolutely preventing sparking at the plugs and plug contacts. The current from each machine may be read by means of its own ammeter and voltmeter, and the output of each adjusted to its proper share of the load by means of shunt-regulating switches. Also the total current of the two main circuits may be read by ammeters in connection with these. Each machine is protected from overloading by magnetic cut-outs of the latest type, and each of the distributing switches has a safety fuse combined with it to protect its own particular circuit.

SWITCHBOARD.